

## **Certification Test Report**

**FCC ID: 2AGLL-AFERO-DB-01**  
**IC: 20929-AFERODB01**

**FCC Rule Part: 15.247**  
**IC Radio Standards Specification: RSS-247**

**ACS Report Number: 16-0056.W04.1A**

**Manufacturer: Afero Inc.**  
**Model: AFERO-DB-01**

**Test Begin Date: March 2, 2016**  
**Test End Date: March 7, 2016**

**Report Issue Date: March 16, 2016**



FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: AT-2021

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

**Reviewed by:**

A handwritten signature in black ink, appearing to read "Kirby Munroe".

**Kirby Munroe**  
**Director, Wireless Certifications**  
**ACS, Inc.**

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**This report contains 13 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 Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for certification.

The purpose of this class II permissive change is to change a single capacitor value.

### **1.2 Product Description**

The AFERO-DB-01 is an Afero secure radio module development kit.

Technical Information:

<b>Detail</b>	<b>Description</b>
Frequency Range	2402 – 2480 MHz
Number of Channels	40
Modulation Format	GFSK
Operating Voltage	5 Vdc
Antenna Type / Gain	PCB Trace Antenna / 0 dBi peak gain

Manufacturer Information:

Afero Inc.  
4970 El Camino Real Suite 100  
Los Altos, CA 94022

EUT Serial Numbers: ACS #4 (Radiated Attached), ACS #5 (Radiated Detached), ACS #7 (RF Conducted)

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

### **1.3 Test Methodology and Considerations**

All modes of operation, including all available data rates, were evaluated. The data presented in this report represents the worst case where applicable.

Testing was limited to Radiated Emissions only due to the capacitor value change. Output power is provided for reference only.

The AFERO-DB-01 is attached to the evaluation board with breakaway tabs on the PCB, therefore the AFERO-DB-01 was tested both attached to the evaluation board and detached from the evaluation board where applicable. Three orientations of the EUT were evaluated to determine worst case. The worst case orientation was determined to be the Z orientation.

Software power setting during test: 0

## **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 ANSI-ASQ National Accreditation Board/ANAB accreditation program, and has been issued certificate number AT-2021 in recognition of this accreditation. 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, Innovation, Science and Economic Development Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 391271

Innovation, Science and Economic Development Canada Lab Code: IC 4175A

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:

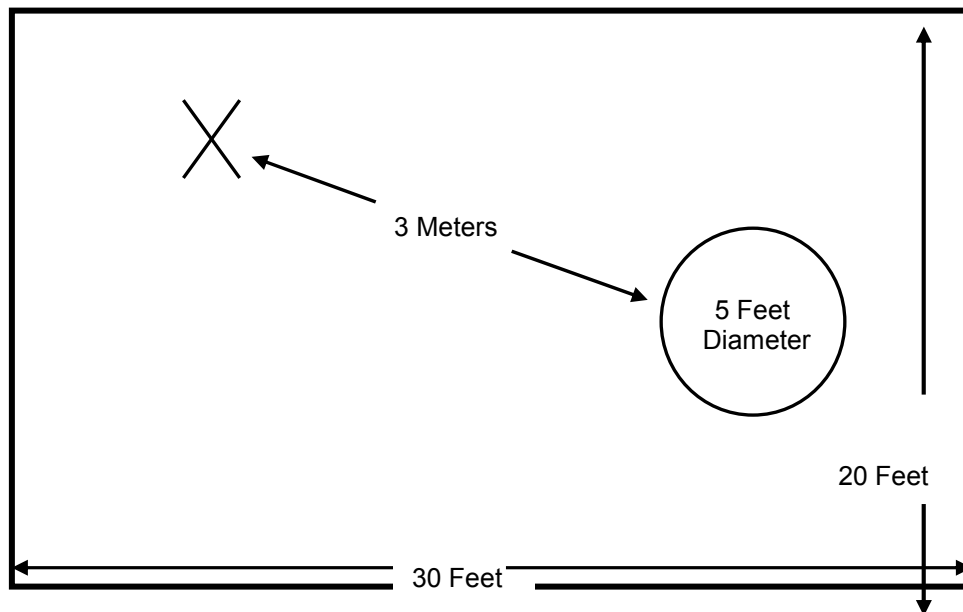


Figure 2.3-1: Semi-Anechoic Chamber Test Site

**2.3.2 Open Area Tests Site (OATS)**

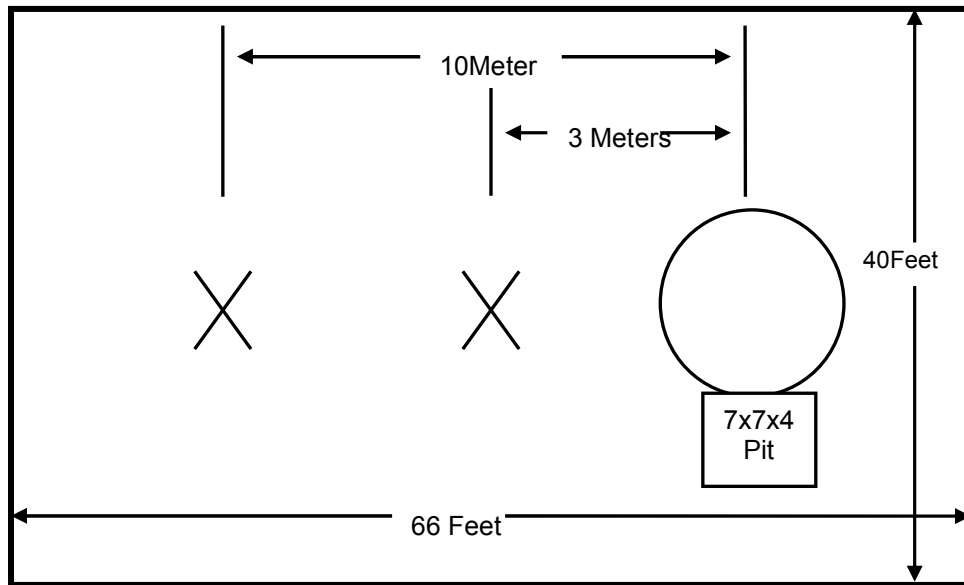
The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide 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:

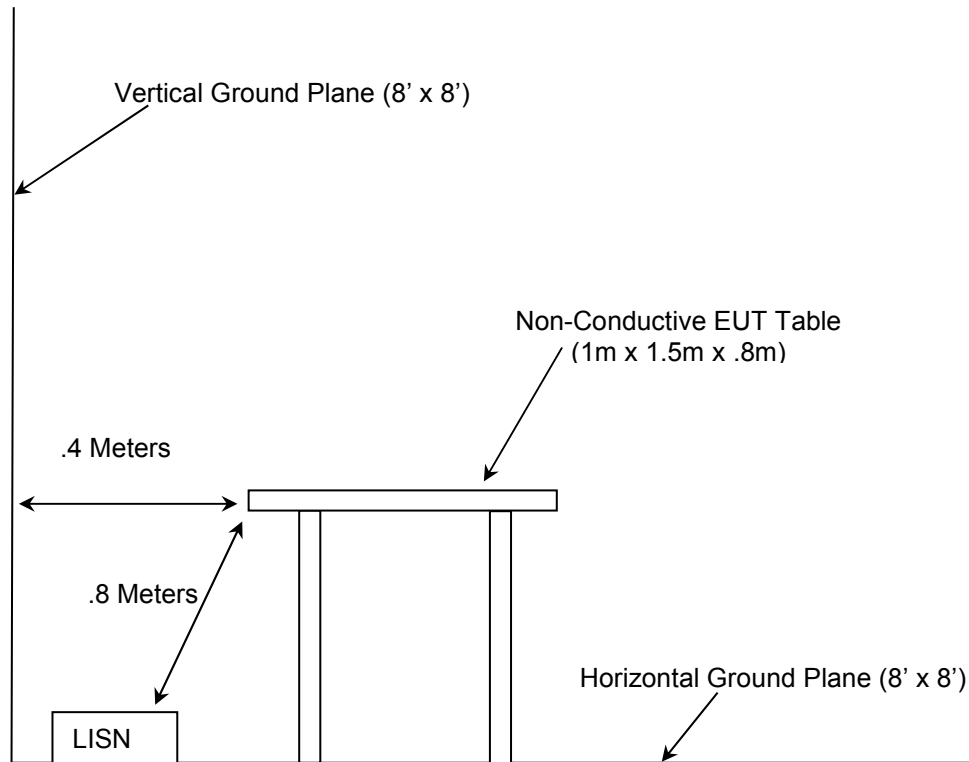


Figure 2.4-1: AC Mains Conducted EMI Site

## 3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ❖ FCC KDB 558074 D01 DTS Meas Guidance v03r04 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, January 7, 2016
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2016
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- ❖ Industry Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015
- ❖ Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 4, Nov 2014.

#### 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	7/14/2015	7/14/2016
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	7/14/2015	7/14/2016
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/30/2015	4/30/2017
40	EMCO	3104	Antennas	3211	2/10/2015	2/10/2017
73	Agilent	8447D	Amplifiers	2727A05624	7/15/2015	7/15/2016
167	ACS	Chamber EMI Cable Set	Cable Set	167	10/20/2015	10/20/2016
267	Agilent	N1911A	Meters	MY45100129	8/24/2015	8/24/2017
268	Agilent	N1921A	Sensors	MY45240184	8/13/2015	8/13/2017
292	Florida RF Cables	SMR-290AW-480.0-SMR	Cables	None	2/17/2016	2/17/2017
334	Rohde&Schwarz	3160-09	Antennas	49404	11/4/2010	NCR
335	Suhner Sucoflex	SF-102A	Cables	882/2A	7/14/2015	7/14/2016
338	Hewlett Packard	8449B	Amplifiers	3008A01111	8/21/2015	8/21/2017
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	7/13/2015	7/13/2016
345	Suhner Sucoflex	102A	Cables	1077/2A	7/14/2015	7/14/2016
412	Electro Metrics	LPA-25	Antennas	1241	7/24/2014	7/24/2016
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	10/30/2015	10/30/2016
432	Microwave Circuits	H3G020G4	Filters	264066	5/20/2015	5/20/2016
616	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	N/A	9/3/2015	9/3/2016



5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model/Part Number	Serial Number
1	Evaluation Board	Afero	Modulo	E-PCB-00007-00
2	Laptop Computer	Lenovo	E530c	MP-2PAH5 13/01
3	Laptop Power Supply	Lenovo	42T4430	11S42T4430Z1 ZGWE24y752
4	USB Hub	Gear Head	UH550ESP	N/A
5	USB Hub Power Supply	Gear Head	SAW-0501000	N/A

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

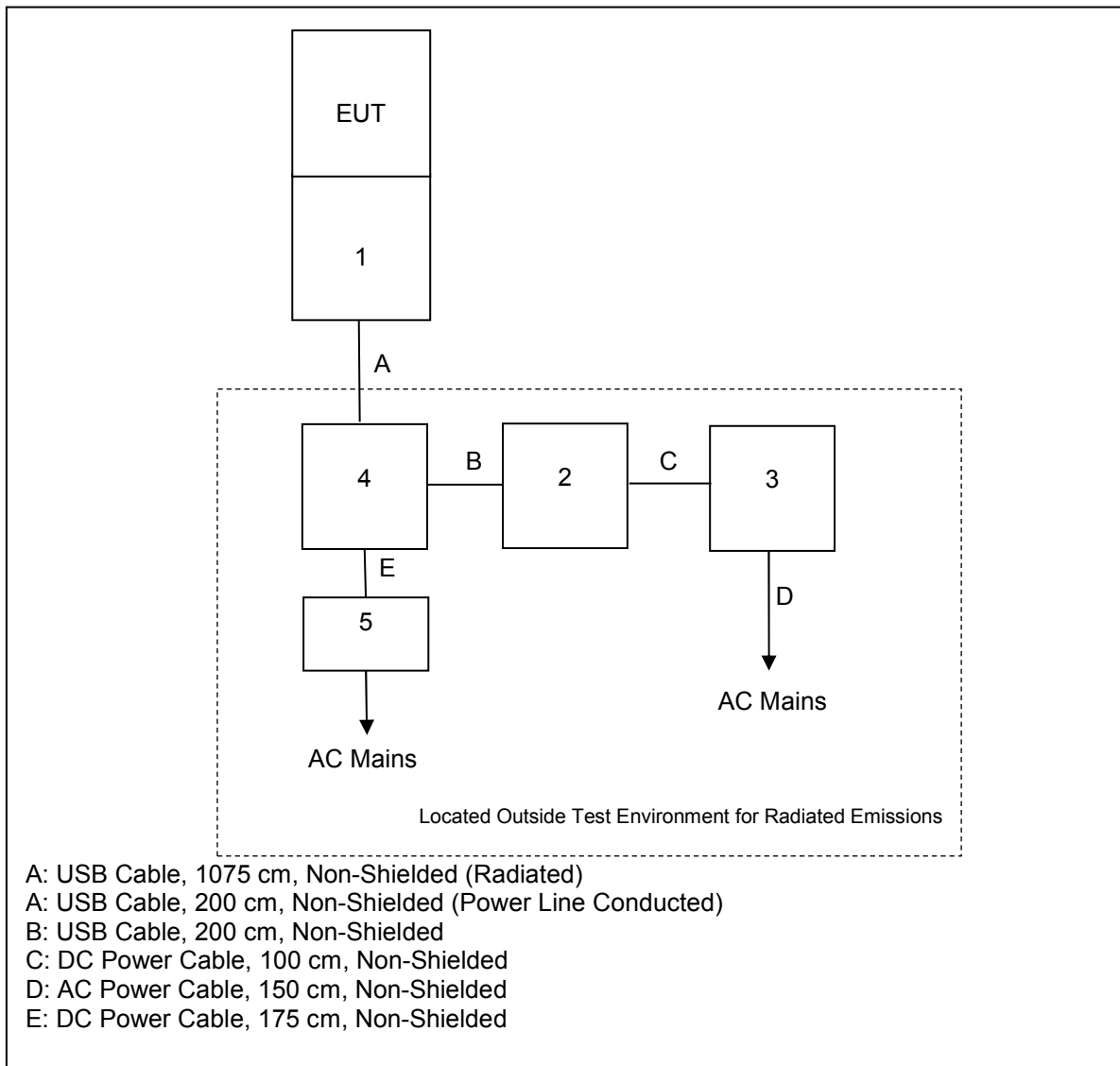


Figure 6-1: Test Setup Block Diagram

## 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 15.203

The EUT utilizes a PCB Trace antenna with a peak gain of 0dBi that is integral to the device and cannot be removed or replaced by the end user.

### 7.2 Fundamental Emission Output Power – FCC 15.247(b)(3), IC: RSS-247 5.4(4)

#### 7.2.1 Measurement Procedure

The maximum peak conducted output power was measured in accordance with FCC KDB 558074 D01 DTS Meas Guidance v03r04 utilizing the PKPM1 Peak power meter method. The RF output of the equipment under test was directly connected to the input of the power meter applying suitable attenuation.

#### 7.2.2 Measurement Results

**Table 7.2.2-1: Maximum Peak Conducted Output Power**

Frequency [MHz]	Level [dBm]
2402	3.90
2440	3.76
2480	3.66

### 7.3 Emissions into Restricted Frequency Bands – FCC 15.205, 15.209; RSS-Gen 8.9/8.10

#### 7.3.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30MHz to 25GHz, 10 times the highest fundamental frequency.

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 1000MHz, quasi-peak measurements were made using a RBW of 120 kHz and a VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

#### 7.3.1.1 Measurement Results

**Table 7.3.1.1-1: Radiated Spurious Emissions Tabulated Data – Attached Eval Board**

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
<b>Low Channel</b>										
4804	52.17	40.19	V	1.97	54.14	42.16	74.0	54.0	19.9	11.8
<b>Middle Channel</b>										
4880	53.44	42.96	V	2.20	55.64	45.16	74.0	54.0	18.4	8.8
<b>High Channel</b>										
2483.5	62.97	40.21	H	-4.93	58.04	35.28	74.0	54.0	16.0	18.7
4960	49.06	37.24	H	2.46	51.52	39.70	74.0	54.0	22.5	14.3
4960	56.19	46.08	V	2.46	58.65	48.54	74.0	54.0	15.4	5.5

**Table 7.3.1.1-2: Radiated Spurious Emissions Tabulated Data – Detached Eval Board**

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
<b>Low Channel</b>										
4804	48.01	38.44	H	1.97	49.98	40.41	74.0	54.0	24.0	13.6
4804	52.12	45.93	V	1.97	54.09	47.90	74.0	54.0	19.9	6.1
<b>Middle Channel</b>										
4880	48.07	37.24	H	2.20	50.27	39.44	74.0	54.0	23.7	14.6
4880	54.02	43.84	V	2.20	56.22	46.04	74.0	54.0	17.8	8.0
<b>High Channel</b>										
2483.5	60.91	40.21	H	-4.93	55.98	35.28	74.0	54.0	18.0	18.7
2483.5	54.70	36.07	V	-4.93	49.77	31.14	74.0	54.0	24.2	22.9
4960	49.06	37.14	H	2.46	51.52	39.60	74.0	54.0	22.5	14.4
4960	55.70	44.00	V	2.46	58.16	46.46	74.0	54.0	15.8	7.5

**7.3.1.2 Sample Calculation:**

$$R_C = R_U + CF_T$$

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

**Example Calculation: Peak**Corrected Level:  $52.17 + 1.97 = 54.14\text{dBuV/m}$ Margin:  $74.0\text{dBuV/m} - 54.14\text{dBuV/m} = 19.9\text{dB}$ **Example Calculation: Average**Corrected Level:  $40.19 + 1.97 - 0 = 42.16\text{dBuV}$ Margin:  $54.0\text{dBuV} - 42.16\text{dBuV} = 11.8\text{dB}$

**8 CONCLUSION**

In the opinion of ACS, Inc. the AFERO-DB-01, provided by Afero Inc. meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247.

**END REPORT**