### Project 18717A-15

# Avex LLC Footbeat Engine

### **Wireless Certification Report**

Prepared for:

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By

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23 Mar 2017

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### **Revision History**

| Revision<br>Number | Description          | Date        |
|--------------------|----------------------|-------------|
| 00                 | Draft 04 for review. | 24 Mar 2017 |
| 01                 | Final.               | 29 Mar 2017 |
|                    |                      |             |
|                    |                      |             |

Corrections:

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NOTICE: (1) This Report must not be used to claim product endorsement, by NVLAP, NIST, the FCC or any other Agency. This report also does not warrant certification by NVLAP or NIST. (2) This report shall not be reproduced except in full, without the written approval of Professional Testing (EMI), Inc. (3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation and the results apply only in reference to the sample tested. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.



# **Compliance Certificate**

| Applicant                     | Device & Test Identification |                 |
|-------------------------------|------------------------------|-----------------|
| Avex LLC (Mark Stephenson)    | FCC ID:                      | 2AKUY-100E      |
| 120 W. Park Drive Suite #205  | Industry Canada ID:          | N/A             |
| Grand Junction, CO 81505      | Model(s):                    | Footbeat Engine |
| Certificate Date: 23 Mar 2016 | Laboratory Project ID:       | 18717A-15       |

The device named above was tested utilizing the following documents and found to be in compliance with the required criteria:

| Requirement          | Reference  | Detail   |  |
|----------------------|--|--|--|
| FCC 47 CFR Part 15 C | 15.247   | Operation within the bands 902-928 MHz, <u>2400-2483.5 MHz</u> , and 5725-5850 MHz.  |  |
| FCC 47 CFR Part 15 C | 15.209   | Radiated emission limits; general requirements.  |  |
| FCC 47 CFR Part 15 C | 15.107, 15.207                                   | Conducted emission limits.   |  |
| FCC 47 CFR Part 15 C | 15.205   | Restricted Bands of Operation  |  |
| KDB 558074 D01       | DR01   | DTS Measurement Guidance v03r02  |  |
| KDB 412172           | D01  | Guidelines for Determining the ERP and EIRP of an RF Transmitting System   |  |
| OET Bulletin 65*     | Edition 97-01, and<br>Supplement C,<br>Ed. 01-01 | Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency<br>Electromagnetic Fields                         |  |
| RSS-247              | Issue 1  | Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-<br>Exempt Local Area Network (LE-LAN) Devices |  |
| RSS-Gen              | Issue 4  | General Requirements and Information for the Certification of Radio Apparatus  |  |
| RSS-102              | Issue 4  | Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)                                   |  |

<sup>\*</sup>MPE is reported separately from this document. \*\*Corresponding RSS references are listed in the body of the report.

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above requirements and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.



This report has been reviewed and accepted by the Applicant. The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

| Representati | ve of Applicant |  |
|--------------|-----------------|--|

#### 1.0 Introduction

#### 1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

#### 1.2 EUT Description

| Table 1.2.1: Equipment Under Test         |      |   |  |
|---|------|---|--|
| Manufacturer / Model Serial # Description |      |   |  |
| Avex LLC                                  | nono | 2400-2483.5 MHz FHSS transceiver; using Bluetooth Low |  |
| Model: Engine                             | none | Energy radio protocols.                               |  |

| Table 1.2.2: Support Equipment       |          |                                |  |
|--------------------------------------|----------|--------------------------------|--|
| Manufacturer / Model                 | Serial # | Description                    |  |
| Avex LLC<br>Model: G~M41134-0612 3.0 | none     | Charger; output 9.0 VDC, 0.66A |  |

The EUT is a therapeutic device for foot massage that is controlled remotely by a companion wireless device designated as the Remote and filed as FCC ID 2AKUY-100R. The device is charged by a supplied power supply strictly when not in use.

The EUT electronics are on a single circuit board which measures approximately 4 cm x 1.5 cm x 0.5 cm. In the final application the EUT fits inside a non-conductive flexible shoe and operates a motorized insole to manually stimulate the foot. It is powered by a rechargeable lithium battery pack when in use.

#### 1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

The EUT was tested as a DTS device as its bandwidth satisfies the DTS minimum bandwidth requirements. In the final application it will also be hopping per the Bluetooth Low Energy protocol.

#### 1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

#### 1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

#### 1.6 Radiated Measurements

Radiated levels are determined as follows:

#### Raw Measured Level + Antenna Factor + Cable Losses - Amplifier Gain = Corrected Level

Conducted RF levels, if applicable, are determined as follows:

Conducted mains levels are determined as follows:

#### Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses = Corrected Level

Additionally, measurement distance extrapolation factors are applied and documented where used.

#### 1.7 Applicable Documents and Clauses

| Table 1.7.1: Applicable Documents   |  |  |
|---|--|--|
| Document  | Title  |  |
| 47 CFR  | Part 15 – Radio Frequency Devices  |  |
| 47 CFK  | Subpart C -Intentional Radiators   |  |
| RSS-247 Issue 1   | Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence- |  |
| N33-247 ISSUE 1   | Exempt Local Area Network (LE-LAN) Devices   |  |
| RSS-Gen Issue 4 General Requirements and Information for the Certification of Radio Apparatus |  |  |
| ANSI C63.10:2013  | American National Standard of Procedures for Compliance Testing of Unlicensed      |  |
| ANSI C63.10.2013  | Wireless Devices   |  |

| Table 1.7.2: Applicable Clauses |                                      |                                  |  |
|---------------------------------|--------------------------------------|----------------------------------|--|
| Parameter                       | FCC Part 15                          | IC RSS References                |  |
| raiailletei                     | Rule Paragraphs                      |                                  |  |
| Transmitter Characteristics     | 15.247                               | RSS-247 5.2 (DTS) & 5.4, RSS-Gen |  |
| Bandwidth                       | 15.247(a)(1), 2.1049, KDB 558074 D01 | RSS-Gen 4.6                      |  |
| Spurious Emission               | 15.247, 15.209, 15.205               | RSS-247 5.5, RSS-GEN 4.9, 4.10   |  |
| Band Edge                       | 15.247, 15.205                       | RSS-247 5.5, RSS-Gen 4.9         |  |
| Antenna Requirement             | 15.203                               | RSS-Gen 8.3                      |  |
| Conducted Emissions, Mains      | 15.207                               | RSS-Gen 8.8                      |  |

#### 2.0 Fundamental Power

#### 2.1 Test Procedure

Peak power is measured using conducted means and with modulation. The transmitter hopping sequence is disabled to operate on a single channel for the measurement.

#### 2.2 Test Criteria

| 47 CFR (USA) // IC (Canada) |  |            |  |  |
|-----------------------------|--|------------|--|--|
| Section Reference           | Parameter                                    | Date       |  |  |
|                             | Fundamental Power                            |            |  |  |
| 15.247(a)(3) //             | Conducted Limits                             | 2 Feb 2017 |  |  |
| RSS-247 5.2                 | 1 W  | 2 Feb 2017 |  |  |
|                             | Limit Restated as Field: 125.23 dBμV/m @ 3 m |            |  |  |

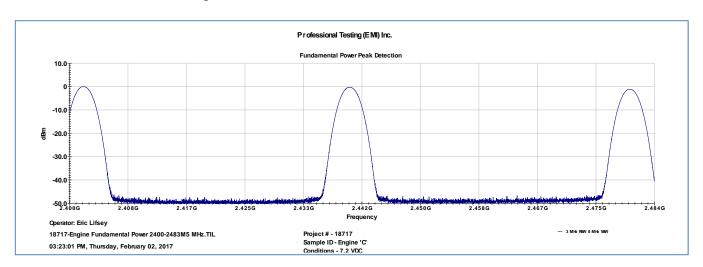
#### 2.3 Test Results, Peak Power

The EUT was measured for conducted power by connection directly to a spectrum analyzer.

| Table 2.3.1 Power, Peak, Conducted                |        |       |  |
|---|--------|-------|--|
| Frequency Measured Peak Power Measured Peak Power |        |       |  |
| MHz   | in dBm | in mW |  |
| 2402  | -0.1   | 0.98  |  |
| 2440  | -0.3   | 0.93  |  |
| 2480  | -1.2   | 0.76  |  |

Measured in 3 MHz RBW, 3 MHz VBW.

The EUT was satisfied the requirements.



#### 2.4 Test Results, Duty Cycle

Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. This is not a pass/fail measurement.

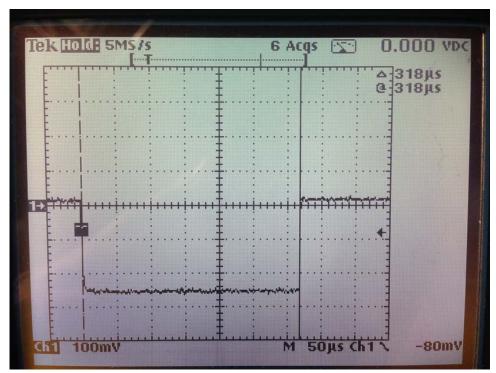
A detector diode, laboratory RF amplifier, and oscilloscope was used for this measurement.

The transmission consisted of a 3 event burst. The total time of the burst was summed, and then the interval between bursts was measured.

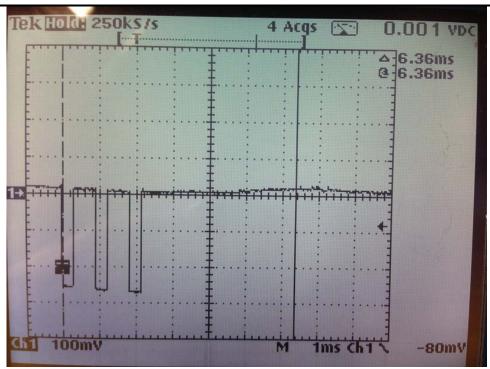
| <b>Table 2.5.1 Du</b>                  | Table 2.5.1 Duty Cycle Results and Average Duty Cycle Factor Result |   |                |   |  |  |  |  |  |  |  |
|--|---|---|----------------|---|--|--|--|--|--|--|--|
| Total<br>Measured<br>On Time<br>(msec) | Measured<br>Time<br>Interval<br>(msec)                              | Duty Cycle Factor Calculation                     | Result<br>(dB) | Duty Cycle<br>Factor<br>Allowed<br>(dB) |  |  |  |  |  |  |  |
| 0.318 X 3<br>= 0.954                   | 100   | = 20 * Log <sub>10</sub> (0.954 msec / 100 msec ) | -40            | -20                                     |  |  |  |  |  |  |  |

The allowed duty cycle factor is applied to peak measured harmonic signals to find average levels.

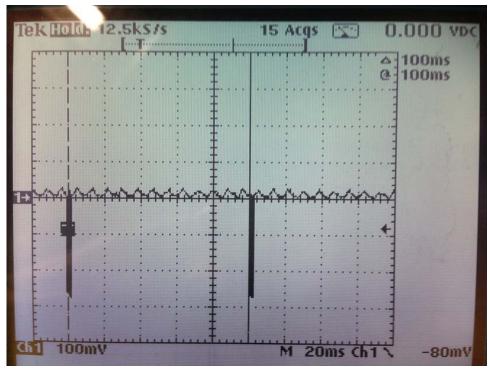
Plotted results appear below.



Transmit Event (3 in a burst, 318 microseconds each)



**Transmit Burst** 



**Transmit Interval** 

### 3.0 Power Spectral Density

#### 3.1 Test Procedure

A spectrum analyzer is either connected directly to the EUT or used by radiated means to measure the fundamental emission. It is adjusted to measure the power spectral density in the specified resolution bandwidth.

#### 3.2 Test Criteria

| 47 CFR (USA) // IC (Canada) |  |      |
|-----------------------------|--|------|
| Section Reference           | Parameter  | Date |
| 15.247(e) // RSS-247, 5.2   | Power Spectral Density, Conducted<br>Limit: 8 dBm / 3 kHz<br>Restated as field strength limit:<br>103.23 dBμV/m at 3 m | NA   |

#### 3.3 Test Results

The fundamental peak power measured below the limit for this test and at a greater resolution bandwidth; the EUT satisfies the criteria without additional measurement.

#### 4.0 Occupied Bandwidth

#### **4.1** Test Procedure

Bandwidth is measured by radiated means. A recording of the results is included.

#### 4.2 Test Criteria

| 47 CFR (USA) // IC (Canada)                            |                        |             |  |  |  |  |  |  |  |  |
|--|------------------------|-------------|--|--|--|--|--|--|--|--|
| Section Reference                                      | Parameter              | Date(s)     |  |  |  |  |  |  |  |  |
| 14.247(a)(2), 2.1049, KDB 558074 D01 //<br>RSS-Gen 4.6 | Bandwidth, 6 dB, 20 dB | 23 Feb 2017 |  |  |  |  |  |  |  |  |

#### 4.3 Test Results

The bandwidth measurement is used to verify DTS characteristics and/or for general reporting for agency application.

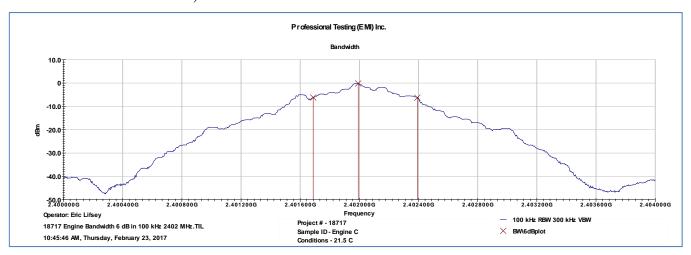
The EUT was found to be in compliance with applicable requirements.

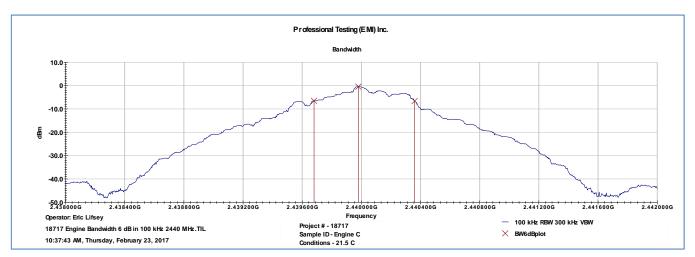
| Table 5.3.1 Bandwidth 6 dB, Minimum 500 kHz in 100 kHz RBW |                                      |             |            |  |  |  |  |  |  |  |
|--|--------------------------------------|-------------|------------|--|--|--|--|--|--|--|
| Low Channel  | Low Channel Mid Channel High Channel |             |            |  |  |  |  |  |  |  |
| Measured BW  | Measured BW                          | Measured BW | Minimum BW |  |  |  |  |  |  |  |
| (kHz)  | (kHz) (kHz) (kHz)                    |             |            |  |  |  |  |  |  |  |
| 704  | 680                                  | 668         | 668        |  |  |  |  |  |  |  |

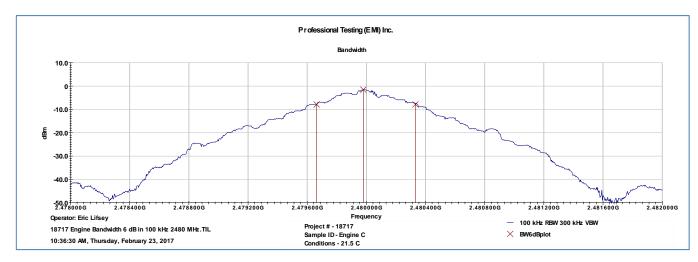
| Table 5.3.2 Bandwidth 20 dB, Measure and Report |             |              |            |  |  |  |  |  |  |  |
|---|-------------|--------------|------------|--|--|--|--|--|--|--|
| Low Channel                                     | Mid Channel | High Channel | Reported   |  |  |  |  |  |  |  |
| Measured BW                                     | Measured BW | Measured BW  | Maximum BW |  |  |  |  |  |  |  |
| (kHz)   | (kHz)       | (kHz)        | (kHz)      |  |  |  |  |  |  |  |
| 1472  | 1472        | 1528         | 1528       |  |  |  |  |  |  |  |

Plotted measurements appear on the following pages.

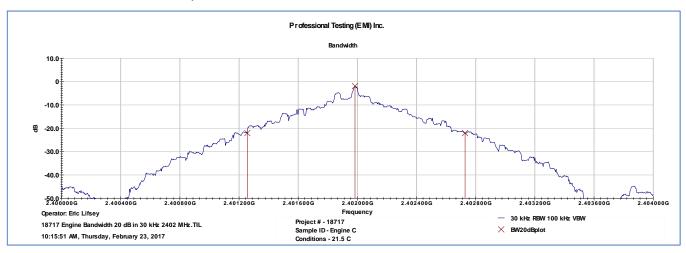
### 4.3.1 Bandwidth Plots, 6 dB

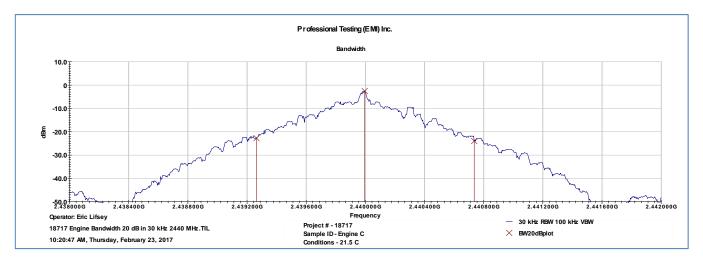


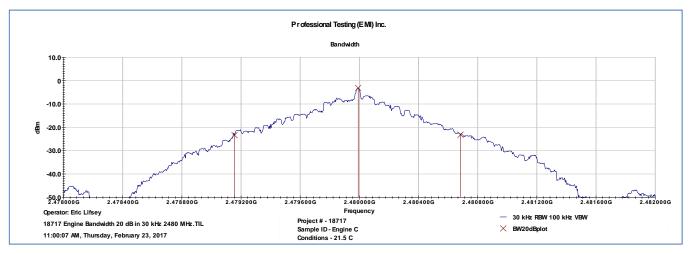




#### 4.3.2 Bandwidth Plots, 20 dB







### 5.0 Band Edge

#### **5.1** Test Procedure

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is approximately centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Measurement includes at least two standard bandwidths from the respective band edge. If required, the band-edge marker-delta method is utilized.

#### 5.2 Test Criteria

| 47 CFR (USA) // IC (Canada) |   |             |
|-----------------------------|---|-------------|
| Section Reference           | Parameter                                 | Date(s)     |
| 15.247, 15.205 //           | Unwanted Emissions Adjacent to Authorized | 22 Fab 2017 |
| RSS-247 5.5, RSS-Gen 4.9    | Band, Radiated                            | 23 Feb 2017 |

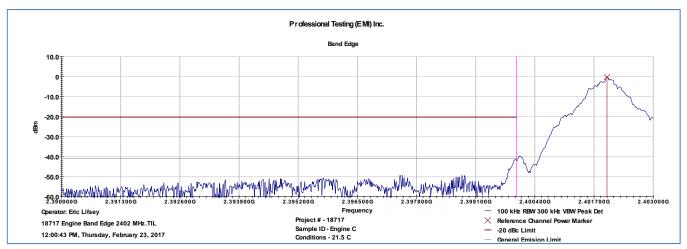
#### 5.3 Test Results

Measurements included more than 2 standard bandwidths (standard bandwidth 1 MHz) from the band edges to provide a clear view of the fundamental and the declining emission levels. Peak detection with max-hold was employed for a conducted measurement.

Applicable Duty Cycle Factor for Averaging Peak Emissions: -20dB

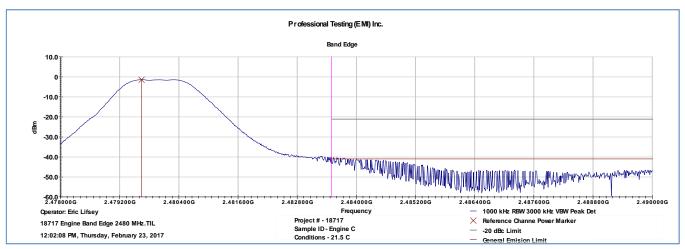
The EUT satisfied the criteria. Plotted results of peak detection appear on the following pages.

### 5.3.1 Low Channel Band Edge



Peak detection in 100 kHz RBW is employed and the DTS limit -20dBc is shown.

### 5.3.2 High Channel Band Edge



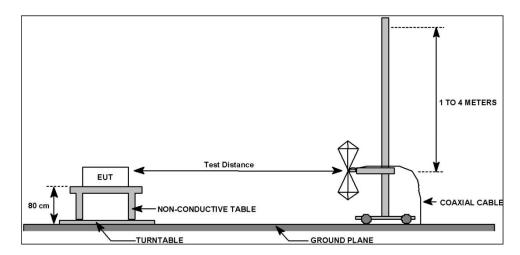
Peak detection is employed while the general emission limits for average and peak levels are shown. The applicable duty cycle factor is -20 dB.

#### 6.0 Radiated Spurious Emissions, Receive Mode

#### **6.1** Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate and 1 MHz resolution bandwidth. A diagram showing the test setup appears below.



#### 6.2 Test Criteria

| 47 CFR (USA) // IC (Canada)                          |   |            |
|--|---|------------|
| Section Reference                                    | Parameter   | Date(s)    |
| 15.247, 15.209 //<br>RSS-247 5.5, RSS-Gen 4.9 & 4.10 | Field Strength of Radiated Spurious/Harmonic Emissions Receive Mode | 7 Feb 2017 |

#### **6.3** Test Results

The EUT was tuned to the middle channel and placed in receive mode. The companion device was also included in this test.

The EUT satisfied the criteria. Recorded data is presented below.

# 6.3.1 Up to 1 GHz

|  |  |                                  | Profes                        | sional Te  | sting, El  | VII, Inc.   |                        |          |              |
|--|--|----------------------------------|-------------------------------|--|--|---|------------------------|----------|--------------|
| Test Metho   | od:  | ANSI C63.10                      |                               |  |  |   |                        |          |              |
| In accordance with:  FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits   |  |                                  |                               |  |  |   |                        |          |              |
| Section:   |  | 15.109                           |                               |  |  |   |                        |          |              |
| Test Date(s  | s):  | 2/7/2017                         |                               |  | EUT Serial   | #:  | 1: 'D', 2: '           | B'       |              |
| Customer:  |  | Avex                             |                               |  | EUT Part #:  |   | NA                     |          |              |
| Project Nui  |  | 18717                            |                               |  | Test Techn   |   | Eric Lifsey            |          |              |
| Purchase O   |  | NA                               |                               |  | Supervisor   |   | Lisa Arnd              | t        |              |
| Equip. Und   | er Test:   | 1: Engine, 2                     | 2: Remote                     |  | Witness' N   | ame:  | None                   |          |              |
|  | F  | Radiated Em                      | nissions Test                 | t Results Data   | a Sheet  |   | Р                      | age: 1   | of 1         |
| EUT Li   | ine Voltage  | 1: 7.2 V                         | VDC                           |  | EUT Pow  | ver Frequen   | icy:                   | 0 N/A    |              |
| Antenna  | a Orientatio   | n:                               | Vertic                        | al   | Frequ  | ency Range  | •                      | 30MHz to | 1GHz         |
| EU   | JT 1 & 2: Re   | ceive Frequ                      | ency 2440 N                   | ИHz  |  | Cor   | ntinuous re            | eceive   |              |
| Frequency<br>Measured<br>(MHz)   | Test Distance (Meters)   | EUT<br>Direction<br>(Degrees)    | Antenna<br>Height<br>(Meters) | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV)  | Corrected<br>Level<br>(dBµV/m)  | Limit Leve<br>(dBµV/m) |          | Test Results |
| 32.3903  | 10   | 136                              | 1.78                          | Quasi-peak   | 24.1   | 12.368  | 29.5                   | -17.1    | Pass         |
| 34.0659  | 10   | 230                              | 3.19                          | Quasi-peak   | 24   | 12.345  | 29.5                   | -17.2    | Pass         |
| 726.998  | 10   | 346                              | 2.32                          | Quasi-peak   | 21.7   | 19.438  | 35.6                   | -16.2    | Pass         |
| 770.136  | 10   | 256                              | 1.57                          | Quasi-peak   | 21.5   | 21.07   | 35.6                   | -14.5    | Pass         |
| 884.356  | 10   | 79                               | 2.05                          | Quasi-peak   | 21.3   | 23.601  | 35.6                   | -12.0    | Pass         |
| 912.992  | 10   | 310                              | 2.31                          | Quasi-peak   | 21.1   | 24.223  | 35.6                   | -11.4    | Pass         |
| Professional Testing, EMI, Inc Radiated Emissions, 10m Distance  30MHz-1GHz Vertical Polarity Measured Emissions  Corrected Peak Value  ∨ Verified Low-PRF QP Reading  PROFESSIONAL  LPRF Verification Limit  PROFESSIONAL |  |                                  |                               |  |  |   |                        |          |              |
| Field Strength (d Bu Vm)   | ×  |                                  |                               |  |  |   |                        | ××       | ××           |
| 10<br>0<br>30M   | Mary Mary Mary Mary Mary Mary Mary Mary  | a property and the second second | 100M                          | d mildle of the same of the sa | A CONTRACTOR OF THE PARTY OF TH | dispersion of the state of the |                        |          | 1G           |
|  | T  |                                  | 200.11                        | Freq   | quency   | ī   | EUT: 1) Engine. 2) R   | emote    |              |
| Operator   | Operator: Eric Lifsey  18717'RESpurious'Run04'ChanMid'RXmode.til  10:07:05 AM, Tuesday, February 07,2017  EUT: 1) Engine, 2) Remote  Project Number: 18717  Client: Avex |                                  |                               |  |  |   |                        |          |              |

|   |  |  |   |  |  |                       |                        |                               | Avex   | LLC – Foo           | tbeat Er | ngine |
|---|--|--|---|--|--|-----------------------|------------------------|-------------------------------|--------|---------------------|----------|-------|
|   |  |  | Profes  | sional Te  | sting, El  | ΜI, I                 | nc.                    |                               |        |                     |          |       |
| Test Metho  | d:   | ANSI C63.1   | 0   |  |  |                       |                        |                               |        |                     |          |       |
| In accordan   | ce with:   | FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits  |   |  |  |                       |                        |                               |        |                     |          |       |
| Section:  |  | 15.109   |   |  |  |                       |                        |                               |        |                     |          |       |
| Test Date(s   | ):   | 2/7/2017   |   |  | EUT Serial   | #:                    |                        | 1: 'D', 2                     | : 'B'  |                     |          |       |
| Customer:   |  | Avex   |   |  | EUT Part #:  |                       |                        | NA                            |        |                     |          |       |
| Project Nur   | nber:  | 18717  |   |  | Test Techn   | ician:                |                        | Eric Lifs                     |        |                     |          |       |
| Purchase O  | rder #:  | NA   |   |  | Supervisor   |                       |                        | Lisa Arn                      | dt     |                     |          |       |
| quip. Und   | er Test:   | 1: Engine  | 2: Remote   |  | Witness' N   | ame:                  |                        | None                          |        |                     |          |       |
|   | F  | Radiated E   | missions Test   | t Results Data   | a Sheet  |                       |                        |                               | Page:  | 1                   | of       | 1     |
| EUT Li  | ne Voltage   | 1: 7.2   | V, 2: 3.0 VDC   |  | EUT Pow  | ver Fre               | quen                   | cy:                           | 0      | N/A                 |          |       |
| Antenna   | Orientatio   | n:   | Horizor   | ntal   | Frequ  | ency R                | lange:                 |                               | 30     | OMHz to             | 1GHz     |       |
| EU  | T 1 & 2: Re  | ceive Freq   | uency 2440 N  | ЛHz  |  |                       | Con                    | tinuous                       | receiv | <i>r</i> e          |          |       |
| Frequency<br>Measured<br>(MHz)  | Test<br>Distance<br>(Meters)   | EUT<br>Direction<br>(Degrees)  | 0   | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV)  | Corre<br>Lev<br>(dBµ) | vel                    | Limit Le                      | -      | Margin<br>(dB)      | Test Re  | sults |
| 34.3452   | 10   | 44   | 3.94  | Quasi-peak   | 23.7   | 12.0                  | 062                    | 29.5                          |        | -17.4               | Pas      |       |
| 764.765   | 10   | 208  | 3.57  | Quasi-peak   | 21.6   | 21.0                  |                        | 35.6                          |        | -14.6               | Pas      |       |
| 806.244   | 10   | 144  | 1.87  | Quasi-peak   | 21.4   | 21.2                  | 257                    | 35.6                          |        | -14.3               | Pas      | s     |
| 879.978   | 10   | 336  | 1.4   | Quasi-peak   | 21.3   | 23.3                  | 398                    | 35.6                          |        | -12.2               | Pas      | s     |
| 891.731   | 10   | 82   | 3.69  | Quasi-peak   | 21.3   | 24.1                  | 122                    | 35.6                          |        | -11.5               | Pas      | s     |
| 937.33  | 10   | 345  | 1.26  | Quasi-peak   | 21.1   | 23.8                  | 392                    | 35.6                          |        | -11.7               | Pas      | s     |
| Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHzHorizontalPolarity Measured Emissions  60   ✓ Verified Low-PRF QP Reading |  |  |   |  |  |                       | PROFESSIO<br>T E S T I |                               |        |                     |          |       |
| 50 — — — — — — — — — — — — — — — — — — —  |  |  |   |  |  |                       |                        |                               |        | x ×                 | ××       | N 6   |
| (dB)  | ×  |  |   |  |  |                       |                        |                               |        |                     | +        |       |
| Strengtl  |  |  |   |  |  |                       |                        |                               | _<br>  | albertle selbstelle |          |       |
| 10  | the contraction of the contracti | million like the state of the s | A STATE OF THE PROPERTY OF THE PARTY OF THE | and the same of th | and the state of t |                       | A later the manner     | Louis Control                 |        |                     |          |       |
| 0±<br>30M   |  |  | 100M  | Free   | quency   |                       |                        |                               |        |                     | 1 G      |       |
| Operator: I   |  |  | Mode: rec   | eiv e, 2440 MHz  | <sub>[ucae]</sub>  |                       |                        | JT: 1) Engine,2               |        |                     |          |       |
|   | Spurious Run 04 'Cha<br>.M, Tuesday, Februa  |  |   |  |  |                       |                        | o ject Number:<br>lient: Avex | 18717  |                     |          |       |
|   |  | ≤ 1  | GHz Horizont  | al Antenna P   | olarity Mea  | sured                 | Emiss                  | ions                          |        |                     |          |       |

## 6.3.2 Up to 13 GHz

|                                |  |   | Profess                           | sional Te             | sting, El                       | MI, Inc.                       |   |                |                         |  |  |
|--------------------------------|--|---|-----------------------------------|-----------------------|---------------------------------|--------------------------------|---|----------------|-------------------------|--|--|
| Test Metho                     | d:   | ANSI C63.10   |                                   |                       |                                 |                                |   |                |                         |  |  |
| In accordar                    | ce with:   | FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits |                                   |                       |                                 |                                |   |                |                         |  |  |
| Section:                       |  | 15.109  |                                   |                       | 1                               |                                |   |                |                         |  |  |
| Test Date(s                    | ):   | 2/7/2017  |                                   |                       | EUT Serial                      |                                | 1: 'D', 2: 'B   | •              |                         |  |  |
| Customer:                      |  | Avex  |                                   |                       | EUT Part #:                     |                                | NA  |                |                         |  |  |
| Project Nur                    |  | 18717   |                                   |                       | Test Techn                      |                                | Eric Lifsey   |                |                         |  |  |
| Purchase O                     |  | NA  |                                   |                       | Supervisor                      |                                | Lisa Arndt  |                |                         |  |  |
| Equip. Und                     | er Test:   | 1: Engine, 2  | 2: Remote                         |                       | Witness' N                      | ame:                           | None  |                |                         |  |  |
|                                | F  | Radiated Em   | issions Test                      | Results Dat           | a Sheet                         |                                | Pa  | ge: 1          | of 1                    |  |  |
| EUT Li                         | ne Voltage:  | 1: 7.2 V  | VDC                               |                       | EUT Pov                         | ver Frequer                    | ncy: (  | N/A            |                         |  |  |
| Antenna                        | Orientatio   | n:  | Vertic                            | al                    | Frequ                           | ency Range                     | :   | Above 1        | GHz                     |  |  |
| EU                             | T 1 & 2: Re  | ceive Frequ   | ency 2440 N                       | ЛНz                   |                                 | Cor                            | ntinuous rec  | eive           |                         |  |  |
| Frequency<br>Measured<br>(MHz) | Test<br>Distance<br>(Meters)                                 | EUT<br>Direction<br>(Degrees)   | Antenna<br>Height<br>(Meters)     | Detector<br>Function  | Recorded<br>Amplitude<br>(dBμV) | Corrected<br>Level<br>(dBµV/m) | Limit Level<br>(dBµV/m)   | Margin<br>(dB) | Test Results            |  |  |
| 1586.5                         | 3  | 81  | 3.9                               | Average               | 35.1                            | 24.357                         | 74.0  | -49.6          | Pass                    |  |  |
| 1620.88                        | 3  | 233   | 1.26                              | Average               | 35.3                            | 24.695                         | 54.0  | -29.3          | Pass                    |  |  |
| 1746.33                        | 3  | 282   | 1.36                              | Average               | 35.4                            | 25.264                         | 54.0  | -28.7          | Pass                    |  |  |
| 10352.4                        | 3  | 337   | 2.13                              | Average               | 26.5                            | 36.599                         | 54.0  | -17.4          | Pass                    |  |  |
| 12016.1                        | 3  | 136   | 3.69                              | Average               | 27.2                            | 37.517                         | 54.0  | -16.4          | Pass                    |  |  |
| Radiated                       | ional Testing,<br>Emissions, 3m Dis<br>erticalPolarity Measu | tance   |                                   |                       |                                 | ▽ Corr                         | age Limit Level ected A verage Reading Limit Level ected Peak Reading |                | PROFESSIONAL<br>TESTING |  |  |
| Field Strength (dg 30)         |  |   | Marin and to the Additional Marin |                       |                                 | All the market on the party of | and the second second description of                                  | 144 Y          | 7                       |  |  |
|                                | čric Lifsey<br>Spurious'Run04'Char<br>.M, Tuesday, Februar   |   | Mode: reco                        | Fre<br>iv e, 2440 MHz | quency                          | 1                              | EUT: 1) Engine,2) Rem<br>Project Number: 18717<br>Client: Avex        |                | 13G                     |  |  |

|  |  |   |  |                                 |                          |                | Δ   | vex LLC | – Foo              | tbeat E  | ngine |
|--|--|---|--|---------------------------------|--------------------------|----------------|---|---------|--------------------|----------|-------|
|  |  | Profess   | sional Te  | sting, El                       | VII, In                  | ıc.            |   |         |                    |          |       |
| est Method:  | ANSI C63.10                                |   |  |                                 |                          |                |   |         |                    |          |       |
| accordance wit   | h·   | FCC Part 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits |  |                                 |                          |                |   |         |                    |          |       |
| ction:   | 15.109                                     |   |  |                                 |                          |                |   |         |                    |          |       |
| est Date(s):   | 2/7/2017                                   |   |  | EUT Serial                      | #:                       |                | l: 'D', 2: '                                      | В'      |                    |          |       |
| ıstomer:   | Avex                                       |   |  | EUT Part #:                     |                          |                | NA AV   |         |                    |          |       |
| oject Number:  | 18717                                      |   |  | Test Techn                      |                          |                | <b>Eric Lifsey</b>                                |         |                    |          |       |
| rchase Order #:  |  |   |  | Supervisor                      |                          |                | isa Arnd  | t       |                    |          |       |
| uip. Under Test  | : '1: Engine, 2                            | 2: Remote   |  | Witness' N                      | ame:                     | 1              | None  |         |                    |          |       |
|  | Radiated Em                                | issions Test  | Results Data   | a Sheet                         |                          |                | P   | age:    | 1                  | of       | 1     |
| EUT Line Vol   | tage: 1: 7.2 V,                            | VDC   |  | EUT Pow                         | ver Fred                 | quenc          | y:  | 0       | N/A                |          |       |
| Antenna Orien  | tation:                                    | Horizon   | ital   | Frequ                           | ency Ra                  | ange:          |   | Ab      | ove 1              | GHz      |       |
| EUT 1 & 2  | 2: Receive Freque                          | ency 2440 N   | ИΗz  |                                 |                          | Conti          | inuous re   | eceive  |                    |          |       |
| requency Tes<br>leasured Distar<br>(MHz) (Mete   | nce Direction                              | Antenna<br>Height<br>(Meters)   | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV) | Correc<br>Leve<br>(dBµV) | el             | Limit Leve<br>(dBμV/m)                            |         | rgin<br>IB)        | Test R   | esult |
| 1000.24 3  | 133  | 1.12  | Average  | 34.5                            | 23.13                    | 19             | 74.0  | -5      | 0.9                | Pa       | SS    |
| 1052.45 3  | 98   | 3.86  | Average  | 35                              | 23.43                    |                | 54.0  | _       | 0.5                | Pa       |       |
| 2795.63 3  | 276  | 1.53  | Average  | 35.5                            | 27.88                    | 87             | 54.0  | -2      | 6.1                | Pa       | ss    |
| 5181.39 3  | 51   | 3.65  | Average  | 31.4                            | 31.5                     | 65             | 54.0  | -2      | 2.4                | Pa       | SS    |
| 6607.93 3  | 109  | 3.88  | Average  | 30.5                            | 32.1                     | 52             | 54.0  | -2      | 1.8                | Pa       | SS    |
| 12442.7 3  | 60   | 2.02  | Average  | 27.4                            | 38.13                    | 35             | 54.0  | -1      | 5.8                | Pa       | SS    |
| Professional Testing, EMI, Inc Radiated Emissions, 3m Distance  1-18GHz Horizontal Polarity Measured Emissions  90 — Peak Limit Leve |  |   |  |                                 |                          | ed AverageRead | ing   |         | PROFESS<br>T E S T |          |       |
| 70 (4 B b V/m)   |  |   |  |                                 |                          |                |   |         |                    |          |       |
| 13 40  |  | the second second second second   | and the state of t | and the latest and address to   |                          |                | 7   |         |                    | <u> </u> |       |
| 30 7   |  |   | Y  |                                 |                          |                |   |         |                    |          |       |
| Operator: Eric Lifsey  | 104'ChanMid'RXmode.til<br>February 07,2017 | Mode: rece  | Free<br>iv e, 2440 MHz   | quency                          |                          | Pro            | Γ: 1) Engine,2) R<br>ject Number: 18'<br>nt: Avex | emote   | 10 <sup>i</sup> G  | 130      | r     |
| 30 de serie Lifsey 18717 RESpurious Rui  | February 07,2017                           |   |  |                                 | isured E                 | Proj<br>Clie   | ject Number: 18'                                  | emote   | 10G                |          | 136   |

## 7.0 Conducted Spurious Emissions, Transmit Mode

#### 7.1 Test Procedure

The EUT was connected directly to a spectrum analyzer for this measurement.

#### 7.2 Test Criteria

| 47 CFR (USA) // IC (Canada)     |                             |            |
|---------------------------------|-----------------------------|------------|
| Section Reference               | Parameter                   | Date(s)    |
| 15.247, 15.209 //               | Spurious/Harmonic Emissions | 2 Feb 2017 |
| RSS-247 5.5, RSS-Gen 4.9 & 4.10 | Transmit Mode               | 21602017   |

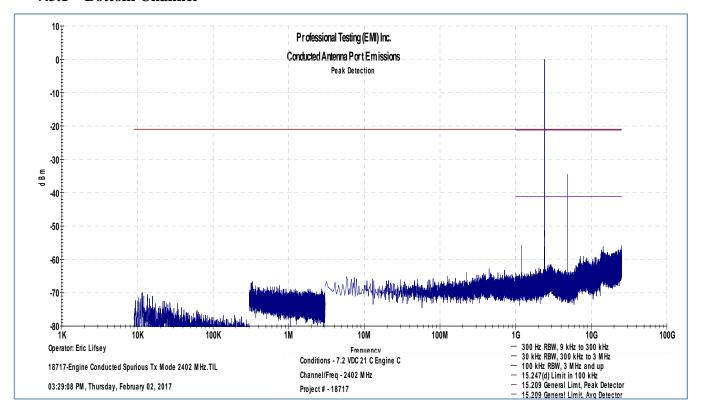
#### 7.3 Test Results

Modulation was enabled for this test and the transmitter was placed into continuous transmit mode. The three standard channels were measured.

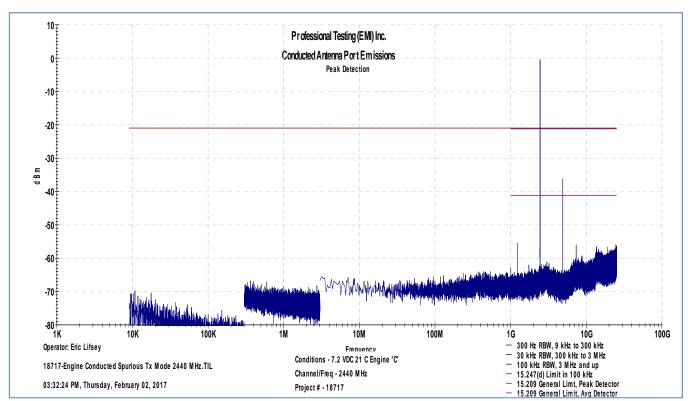
The duty cycle averaging factor applies -20.0 dB to the peaks recorded for the harmonics. Since the peak measurement satisfied the peak limit with margin, the average emission would equally satisfy the average limit.

All measurements used peak detection.

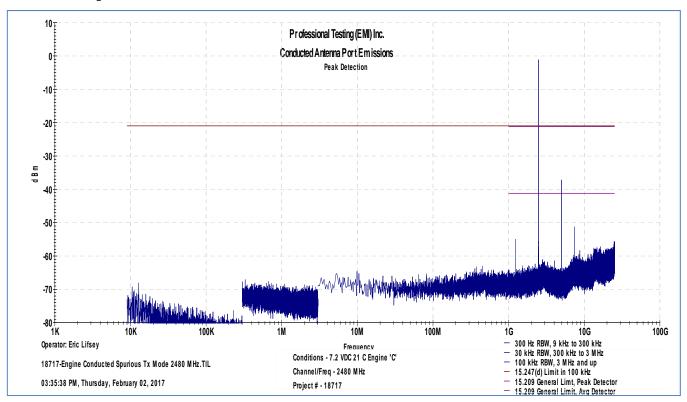
#### 7.3.1 Bottom Channel



#### 7.3.2 Middle Channel



# 7.3.3 Top Channel

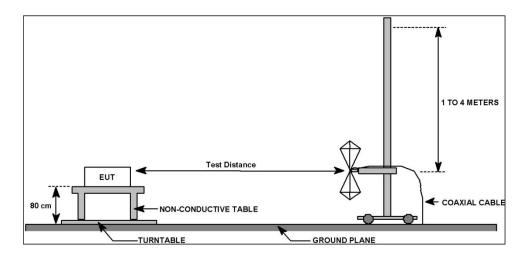


#### **8.0** Radiated Spurious Emissions, Transmit Mode

#### **8.1** Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate using 1 MHz resolution bandwidth. A diagram showing the test setup appears below.



#### 8.2 Test Criteria

| 47 CFR (USA) // IC (Canada)                          |  |                          |
|--|--|--------------------------|
| Section Reference                                    | Parameter  | Date(s)                  |
| 15.247, 15.209 //<br>RSS-247 5.5, RSS-Gen 4.9 & 4.10 | Field Strength of Radiated<br>Spurious/Harmonic Emissions<br>Transmit Mode | 3 Feb 2017<br>6 Feb 2017 |

#### 8.3 Test Results

This device was simultaneously tested with its companion device designated Remote. A very low resolution bandwidth was used during setup to confirm the two fundamental signals were present.

Modulation was enabled for this test and the transmitter was placed into continuous transmit mode.

The duty cycle averaging factor applies -20.0 dB to the peaks recorded for the harmonics. As all peaks were below the peak limit, the averaged emissions are also below the average limit.

# 8.3.1 Middle Channel Up to 1 GHz

|   |   |                               | Profes                        | sional Te  | sting, El                       | MI, Inc.   | •   |                              |                 |                     |        |
|---|---|-------------------------------|-------------------------------|--|---------------------------------|--|---|------------------------------|-----------------|---------------------|--------|
| Test Metho                              | od:   | ANSI C63.1                    | 0                             |  |                                 |  |   |                              |                 |                     |        |
| In accorda                              | nce with:   | Limits                        | .209 - Code of                | Federal Regulat  | ions Part 47,                   | Subpart C - I                                    | ntentional  | Radiators                    | s, Radiate      | ed Emiss            | ions   |
| Section:                                |   | 15.209                        |                               |  | 1                               |  |   |                              |                 |                     |        |
| Test Date(                              | s):   | 2/3/2017                      | , 2/6/2017                    |  | EUT Serial                      |  | 1: 'D', 2   | 2: 'B'                       |                 |                     |        |
| Customer:                               |   | Avex                          |                               |  | EUT Part #:                     |  | NA  |                              |                 |                     |        |
| Project Nu                              |   | 18717                         |                               |  | Test Techn                      |  | Eric Life   |                              |                 |                     |        |
| Purchase C                              |   | NA                            |                               |  | Supervisor                      |  | Lisa Ar   | ndt                          |                 |                     |        |
| Equip. Und                              | ler Test:   | 1: Engine                     | 2: Remote                     |  | Witness' N                      | ame:   | None  |                              |                 |                     |        |
|   | F   | Radiated E                    | missions Test                 | Results Data   | a Sheet                         |  |   | Page:                        | 1               | of                  | 1      |
| EUT L                                   | ine Voltage:  | 1: 7.2                        | V, 2: 3.0 VDC                 |  | EUT Pov                         | ver Freque                                       | ency:   | 0                            | N/A             |                     |        |
| Antenn                                  | a Orientatio  | n:                            | Vertic                        | al   | Frequ                           | ency Rang  | e:  | 30                           | MHz to          | 1GHz                |        |
| EU                                      | T 1 & 2: Tra  | nsmit Fred                    | quency 2440                   | MHz  |                                 | Continuo   | ıs transm   | it unmo                      | dulated         | ł                   |        |
| Frequency<br>Measured<br>(MHz)          | Test<br>Distance<br>(Meters)                                  | EUT<br>Direction<br>(Degrees) | Antenna<br>Height<br>(Meters) | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV) | Corrected<br>Level<br>(dBµV/m                    | Limit Le  |                              | /largin<br>(dB) | Test Ro             | esults |
| 30.0008                                 | 10  | 250                           | 1.25                          | Quasi-peak   | 28.1                            | 16.282   | 29.5  | 5                            | -13.2           | Pas                 | SS     |
| 135.439                                 | 10  | 7                             | 1.65                          | Quasi-peak   | 34                              | 16.717   | 33.1  | 1 .                          | -16.4           | Pas                 | ss     |
| 210.686                                 | 10  | 97                            | 1.24                          | Quasi-peak   | 24.9                            | 10.071   | 33.1  | 1                            | -23.0           | Pas                 | SS     |
| 318.111                                 | 10  | 10                            | 1.25                          | Quasi-peak   | 32.6                            | 22.79  | 35.6  | 5                            | -12.8           | Pas                 | SS     |
| 414.157                                 | 10  | 205                           | 4.1                           | Quasi-peak   | 25.7                            | 18.45  | 35.6  | 5                            | -17.2           | Pas                 | SS     |
| 459.507                                 | 10  | 104                           | 3.83                          | Quasi-peak   | 27.4                            | 19.684   | 35.6  | 5                            | -15.9           | Pas                 | SS     |
| 770.408                                 | 10  | 212                           | 4.08                          | Quasi-peak   | 22.9                            | 22.524   | 35.6  | 5                            | -13.1           | Pas                 | ss     |
| Radiated 30MHz - 1                      | sional Testing,<br>Emissions, 10m Di<br>GHz Vertical Polarity | stance                        |                               |  |                                 | <ul><li>∇ Co</li><li>− Co</li><li>∇ Vo</li></ul> | asi-peak Limit Le<br>rrected Quasi-pea<br>rrected Peak Valu<br>rified Low-PRF Q<br>RF Verification Li | ak Reading<br>ue<br>PReading | X               | PROFESSI<br>T E S T |        |
| Field Strength (d B µ V/m)              |   |                               |                               | ×  | X                               |  | × × ×   |                              |                 |                     |        |
| 10 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | harry and the state of the state of the state of              | A PARTY AND LANGUAGE          | And bearing the second second | <b>V</b>   |                                 |  |   |                              |                 | -                   |        |
| Operator:<br>18717'RE                   | Eric Lifsey<br>'Spurious'Run01'Cha<br>AM,Friday,February      |                               | MHzGHz.til Freq MHz           | Freq<br>nsmit, continuous, 2440<br>Range: 2440 MHz<br>Range: 1: 2440 GHz, 2: |                                 |  | EUT: 1) Engine<br>Project Number<br>Client: A vex   |                              |                 | 1 <b>G</b>          |        |

| EUT Line Voltage: 1-7.2 v, 2-3.0   VDC   EUT Power Frequency: 0   N/A  |                          |   |  |               |                                 |  |                  |                    | A   | vex LLC – Foo    | otbeat Engine           |
|--|--------------------------|---|--|---------------|---------------------------------|--|------------------|--------------------|---|------------------|-------------------------|
| In accordance with:    FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emission Limits   Section:   15.209  |                          |   |  |               | Profes                          | sional Te                                  | sting, El        | VII, Inc.          |   |                  |                         |
| Section:   15.209  | Test Metho               | d:  | ANSI C   | 53.10         |                                 |  |                  |                    |   |                  |                         |
| Test Date(s):  | In accordan              | ice with:   |  | t 15.2        | 09 - Code of I                  | Federal Regulat                            | ions Part 47, S  | Subpart C - Ir     | itentional Rac  | liators, Radiato | ed Emissions            |
| Customer:   Avex   |                          |   |  |               |                                 |  | 1                |                    | ,   |                  |                         |
| Project Number: 18717 Test Technician: Eric Lifsey Purchase Order #: NA Supervisor: Lisa Arndt Equip. Under Test: 1: Engine, 2: Remote Witness' Name: None  Radiated Emissions Test Results Data Sheet Page: 1 of 1  EUT Line Voltage: 1: 7.2 V, 2: 3.0 VDC EUT Power Frequency: 0 N/A  Antenna Orientation: Horizontal Frequency Range: 30MHz to 1GHz  EUT 1 & 2: Transmit Frequency 240 MHz  Continuous transmit unmodulated  Frequency Test Distance (Indeters) Distance (Indeters) Distance (Indeters) (Indeters) (Indeters) Distance (Indeters) Distance (Indeters) (Indeters) Distance (Indeters) Di | Test Date(s              | ):  | 2/3/20   | 017, 2        | 2/6/2017                        |  |                  |                    |   | В'               |                         |
| Purchase Order #: NA   |                          |   |  |               |                                 |  |                  |                    |   |                  |                         |
| Radiated Emissions Test Results Data Sheet   Page: 1 of 1  |                          |   | _  |               |                                 |  |                  |                    |   |                  |                         |
| Radiated Emissions Test Results Data Sheet   Page: 1 of 1  |                          |   | _  |               |                                 |  | -                |                    | _   |                  |                         |
| EUT Line Voltage: 1:7.2 \( \frac{1}{2} \), 2:3.0 \  VDC   EUT Power Frequency: 0 \ N/A   | Equip. Und               | er Test:  | 1: Eng   | ine, 2        | 2: Remote                       |  | Witness' N       | ame:               | None  |                  |                         |
| Antenna Orientation:   Horizontal   Frequency Range:   30MHz to 1GHz   |                          | F   |  |               |                                 | Results Data                               | a Sheet          |                    | Pa  | age: 1           | of 1                    |
| Frequency   Test   EUT   Antenna   Detector   GMHz   Distance   Direction   (Meters)     | EUT Li                   | ne Voltage  | :  | 1: 7.2 V<br>V | VDC                             |  | EUT Pow          | ver Freque         | ncy:  | 0 N/A            |                         |
| Test   Direction (Measured (MHz)   Direction (Meters)   Direction (Me    | Antenna                  | Orientatio  | n:   |               | Horizor                         | ntal                                       | Frequ            | ency Range         | ):  | 30MHz to         | 1GHz                    |
| Measured (MHz)   | EU                       | T 1 & 2: Tra  | nsmit I  | Frequ         | iency 2440                      | MHz  |                  | Continuou          | s transmit u  | ınmodulate       | d                       |
| 30.0952 10 357 1.23 Quasi-peak 23.8 11.998 29.5 -17.5 Pass 137.745 10 292 1.33 Quasi-peak 24.4 7.256 33.1 -25.8 Pass 184.071 10 317 1.14 Quasi-peak 23.3 8.155 33.1 -24.9 Pass 322.046 10 303 1.35 Quasi-peak 22.6 13.042 35.6 -22.6 Pass 885.963 10 277 3.12 Quasi-peak 21.3 23.73 35.6 -11.9 Pass 916.369 10 29 3.51 Quasi-peak 21.2 24.24 35.6 -11.4 Pass Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30 MHz-1 GHz Horizontal Polarity Measured Emissions (40 MHz-1 GHz Horizontal Polarity Measured Emissions (50 MHz-1 GHz Horizontal Polarity Measured Emissions (60 MHz-1 GHz Horizontal Polarity Measured Emissions (60 MHz-1 GHz Horizontal Polarity Measured Emissions (70 MHz-1 GHz Horizontal Polarity MHz-1 GHz Horizontal Polarity MHz-1 GHz Horizontal Polarity MHz | Measured                 | Distance  | Direct   | tion          | Height                          |  | Amplitude        | Level              |   |                  | Test Results            |
| 137.745 10 292 1.33 Quasi-peak 24.4 7.256 33.1 -25.8 Pass 184.071 10 317 1.14 Quasi-peak 23.3 8.155 33.1 -24.9 Pass 322.046 10 303 1.35 Quasi-peak 22.6 13.042 35.6 -22.6 Pass 885.963 10 277 3.12 Quasi-peak 21.3 23.73 35.6 -11.9 Pass 916.369 10 29 3.51 Quasi-peak 21.2 24.24 35.6 -11.4 Pass Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions  Professional Testing, EMI, Inc Radiated Emissions 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions  Professional Testing, EMI, Inc Radiated Emissions 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions 10m Distance 200 MHz-1GHz Horizontal Polarity Measured Emissions 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions 10m Distance 200 MHz-1GHz Horizontal Polarity Measu |                          |   |  | -             |                                 | Ouasi-neak                                 |                  |                    | 29.5  | -17 5            | Pass                    |
| 184.071 10 317 1.14 Quasi-peak 23.3 8.155 33.1 -24.9 Pass 322.046 10 303 1.35 Quasi-peak 22.6 13.042 35.6 -22.6 Pass 885.963 10 277 3.12 Quasi-peak 21.3 23.73 35.6 -11.9 Pass 916.369 10 29 3.51 Quasi-peak 21.2 24.24 35.6 -11.4 Pass Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions  Professional Testing, EMI, Inc Radiated Emissions 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions  Professional Testing, EMI, Inc Radiated Emissions 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions 10m Distance 200 Testing Emissions 10 |                          |   |  |               |                                 |  |                  |                    |   | _                |                         |
| 322.046 10 303 1.35 Quasi-peak 22.6 13.042 35.6 -22.6 Pass 885.963 10 277 3.12 Quasi-peak 21.3 23.73 35.6 -11.9 Pass 916.369 10 29 3.51 Quasi-peak 21.2 24.24 35.6 -11.4 Pass Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions (10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions 40 Verified Low-PRF QP Reading Verified to Law-PRF QP Reading Verified to Law-PRF QP Reading Verified Low-PRF QP Reading Verified Low-PRF QP Reading Verified to Law-PRF QP Reading Verified Low-PRF QP Reading Ve |                          | 10  |  |               |                                 | •  |                  |                    | 33.1  |                  |                         |
| 885.963 10 277 3.12 Quasi-peak 21.3 23.73 35.6 -11.9 Pass 916.369 10 29 3.51 Quasi-peak 21.2 24.24 35.6 -11.4 Pass Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions   |                          |   |  |               |                                 | •  | _                |                    |   | _                |                         |
| Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions  Operator: EricLifsey  Operator: EricLifsey  Mode: transmit, continuous, 2440 MHz, power 0 dBm  Mode: transmit, continuous, 2440 MHz, power 0 dBm  Mode: transmit, continuous, 2440 MHz, power 0 dBm   |                          | 10  |  |               | _                               | •  |                  |                    | 35.6  | -11.9            | Pass                    |
| Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Horizontal Polarity Measured Emissions  |                          | 10  | 29   | )             | ,                               | •  | _                | 24.24              | <del></del>   | -11.4            | Pass                    |
| Operator: Eric Lifsey  Frequency  Frequency  Frequency  Mode: transmit, continuous, 2440 MHz, power 0 dBm  Description of the Middle Broad Broad School Middle Broad School Middle Broad Broad School Mi | Radiated 30MHz-10        | Emissions, 10m Di   | istance  |               | 5                               |  |                  | ▽ Cor ─ Cor ▽ Veri | rected Quasi-peak Rea<br>rected Peak Value<br>fied Low-PRF QP Rea |                  | PROFESSIONAL<br>TESTING |
| Operator: Eric Lifsey  Mode: transmit, continuous, 2440 MHz, power 0 dBm  EUT: 1) Engine, 2) Remote  Mode: transmit, continuous, 2440 MHz, power 0 dBm   | ŧ                        |   |  |               |                                 | ·  |                  | X                  |   |                  | ××                      |
| Operator: Eric Lifsey Frequency EUT: 1) Engine, 2) Remote  Mode: transmit, continuous, 2440 MHz, power 0 dBm   | J. Marketty              | Market | and the state of t |               |                                 | ×  |                  |                    |   |                  |                         |
| Operator: Eric Lifsey Frequency EUT: 1) Engine, 2) Remote  12717 PES-union Pure 0 (Shar Middle Para 0 Alba Mula Citata Mode: transmit, continuous, 2440 MHz, power 0 dBm   | 0 ± 30 M                 |   |  |               | 100M                            |  |                  |                    |   |                  | 1G                      |
| 11:29:19 AM, Friday, February 03,2017 Freq MHz Range: 2440 MHz Troyce Number: 18717 Freq GHz Range: 1: 2440 GHz, 2: 2440 GHz  Client: Avex   | Operator: 1<br>18717 RES | Spurious Run 01 'Cha  |  | 0 d Bm'M F    | Mode: tra<br>HzGHz.til Freq MHz | nsmit, continuous, 2440<br>Range: 2440 MHz | MHz, power 0 dBm |                    | Project Number: 187   |                  |                         |

# 8.3.2 Middle Channel Up to 18 GHz

|   |   |                                   | Profess                       | sional Te                         | sting, El                                | ΜI, I  | Inc.                   |  |         |                |                         |
|---|---|-----------------------------------|-------------------------------|-----------------------------------|--|--------|------------------------|--|---------|----------------|-------------------------|
| Test Metho                              | od:   | ANSI C63.10                       |                               |                                   |  |        |                        |  |         |                |                         |
| n accordaı                              | nce with:   | FCC Part 15.2<br>Limits           | 209 - Code of F               | ederal Regula                     | tions Part 47,                           | Subpar | rt C - Int             | entional   | Radiat  | ors, Radiate   | ed Emissions            |
| Section:                                |   | 15.209                            |                               |                                   |  |        |                        |  |         |                |                         |
| Test Date(s                             | s):   | 2/3/2017,                         | 2/6/2017                      |                                   | EUT Serial                               |        |                        | 1: 'D',  | 2: 'B'  |                |                         |
| Customer:                               |   | Avex                              |                               |                                   | EUT Part #                               |        |                        | NA   |         |                |                         |
| Project Nu                              |   | 18717                             |                               |                                   | Test Techn                               |        |                        | Eric Lif   |         |                |                         |
| Purchase C                              |   | NA                                |                               |                                   | Supervisor                               |        |                        | Lisa Ar  | ndt     |                |                         |
| quip. Und                               | ler Test:   | 1: Engine,                        | 2: Remote                     |                                   | Witness' N                               | ame:   |                        | None   |         |                |                         |
|   | F   |                                   |                               | Results Dat                       | a Sheet                                  |        |                        |  | Page    | : 1            | of 1                    |
| EUT L                                   | ine Voltage   | 1: 7.2 V                          | VDC                           |                                   | EUT Pov                                  | ver Fr | equen                  | cy:  | 0       | N/A            |                         |
| Antenn                                  | a Orientatio  | on:                               | Vertic                        | al                                | Frequ                                    | ency   | Range:                 |  |         | Above 1        | GHz                     |
| EU                                      | T 1 & 2: Tra  | ınsmit Frequ                      | uency 2440 I                  | MHz                               |  | Conti  | nuous                  | transm   | nit unn | nodulated      | t                       |
| Frequency<br>Measured<br>(MHz)          | Test<br>Distance<br>(Meters)  | EUT<br>Direction<br>(Degrees)     | Antenna<br>Height<br>(Meters) | Detector<br>Function              | Recorded<br>Amplitude<br>(dBμV)          | Le     | ected<br>evel<br>iV/m) | Limit Lo   |         | Margin<br>(dB) | Test Result             |
| 4879.99                                 | 3   | 106                               | 3.16                          | Average                           | 66.1                                     | 62     | .575                   | 74.0   | 0       | -11.4          | Pass                    |
| 7324.19                                 | 3   | 50                                | 3.19                          | Average                           | 31                                       | 34     | .274                   | 54.0   | 0       | -19.7          | Pass                    |
| 9772.86                                 | 3   | 294                               | 1.17                          | Average                           | 26.1                                     | 33     | .841                   | 54.0   | 0       | -20.1          | Pass                    |
| 12195.6                                 | 3   | 44                                | 1.64                          | Average                           | 26.5                                     | 36     | .935                   | 54.0   | 0       | -17.0          | Pass                    |
| 14638                                   | 3   | 27                                | 2.91                          | Average                           | 27.6                                     | 38     | .713                   | 54.0   | 0       | -15.2          | Pass                    |
| 17083.6                                 | 3   | 257                               | 3.65                          | Average                           | 27.1                                     | 38     | .743                   | 54.0   | 0       | -15.2          | Pass                    |
| Radiated                                | sional Testing,<br>Emissions, 3m Dis<br>Vertical Polarity Meass   | tance                             |                               |                                   |  |        | ∨ Corre                | ge Limit Level<br>cted Average<br>Limit Level<br>cted Peak Rea | Reading |                | PROFESSIONAL<br>TESTING |
| Field Strength (dBµV/m)  09             |   | +                                 |                               |                                   | ▼  |        | <del> </del>           |  |         |                | - —  <br>- <u> </u>     |
| 30 - 30 - 30 - 30 - 30 - 30 - 30 - 30 - | Jenes Leine | and the consistency of the second |                               | Make a let the water for a sea by | estales polycles, and control technology |        | Y                      | Y  |         | <u> </u>       | Y                       |
| 50                                      |   |                                   |                               |                                   |  |        |                        | 1  | 0 G     |                | 18G                     |
| 201 G                                   |   |                                   |                               |                                   |  |        |                        |  |         |                |                         |

|   |  |  |  |  |  |                              |   | Avex         | LLC – Foo      | tbeat Engin          |
|---|--|--|--|--|--|------------------------------|---|--------------|----------------|----------------------|
|   |  |  | Profess  | sional Te  | sting, El  | VII, Inc                     |   |              |                |                      |
| Test Metho  | od:  | ANSI C63.  | 10   |  |  |                              |   |              |                |                      |
| In accordar   | nce with:  | FCC Part 1 Limits  | L5.209 - Code of F   | ederal Regula  | tions Part 47,   | Subpart C -                  | Intentiona  | l Radiato    | rs, Radiate    | ed Emissions         |
| Section:  |  | 15.209   |  |  |  |                              |   |              |                |                      |
| Test Date(s   | s):  | <u> </u>   | 7, 2/6/2017  |  | EUT Serial   |                              | 1: 'D',   | 2: 'B'       |                |                      |
| Customer:   |  | Avex   |  |  | EUT Part #   |                              | NA  |              |                |                      |
| Project Nui   |  | 18717  |  |  | Test Techn   |                              | Eric Li   | •            |                |                      |
| Purchase O  |  | NA   |  |  | Supervisor   |                              | Lisa A  | rndt         |                |                      |
| Equip. Und  | er Test:   | 1: Engin   | e, 2: Remote   |  | Witness' N   | ame:                         | None  |              |                |                      |
|   | F  | Radiated   | Emissions Test   | Results Dat  | a Sheet  |                              |   | Page         | 1              | of 1                 |
| EUT Li  | ine Voltage  | 1: 7   | VDC  |  | EUT Pov  | ver Frequ                    | ency:   | 0            | N/A            |                      |
| Antenna   | a Orientatio   | n:   | Horizon  | ntal   | Frequ  | ency Ran                     | ge:   |              | Above 1        | GHz                  |
| EU  | T 1 & 2: Tra   | nsmit Fr   | equency 2440 I   | MHz  |  | Continuo                     | us transr   | nit unm      | odulated       | ł                    |
| Frequency<br>Measured<br>(MHz)  | Test Distance (Meters)   | EUT<br>Directio<br>(Degree   |  | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV)  | Correcte<br>Level<br>(dBµV/n | Limit I   |              | Margin<br>(dB) | Test Results         |
| 4880  | 3  | 59   | 2.94   | Average  | 73   | 69.469                       | 74  | .0           | -4.5           | Pass                 |
| 7320.13   | 3  | 350  | 2.1  | Average  | 29.5   | 32.731                       | . 54  | .0           | -21.2          | Pass                 |
| 9755.08   | 3  | 271  | 3.71   | Average  | 26.2   | 33.904                       | 54  | .0           | -20.1          | Pass                 |
| 12197.7   | 3  | 19   | 1.45   | Average  | 26.5   | 36.929                       | 54  | .0           | -17.0          | Pass                 |
| 14642.1   | 3  | 242  | 2  | Average  | 27.6   | 38.7                         | 54  | .0           | -15.3          | Pass                 |
| 17065.8   | 3  | 34   | 2.15   | Average  | 27.1   | 38.857                       | 54  | .0           | -15.1          | Pass                 |
| Radiated  | sional Testing,<br>Emissions, 3m Dis<br>Horizontal Polarity Mo | tance  |  |  |  | ▽ (                          | verage Limit Lev<br>Corrected Averag<br>Ceak Limit Level<br>Corrected Peak Re | e Reading    |                | PROFESSIONAL TESTING |
|   |  |  |  |  |  |                              |   |              |                | TESTING              |
| 70 (q B μ V)m) 60 (4 B μ V)m) 40 (4 |  |  |  |  | Y  |                              |   |              |                |                      |
| Sield Streng  |  |  |  | Library and About State of Library   | and the latest the lat |                              |   |              |                |                      |
| 30  | willian be the stage   | water to be supplied to the su | A CONTRACTOR OF THE PARTY OF TH |  |  | <u> </u>                     |   | y<br>        | <u> </u>       | - <u>Y</u>           |
| 20 G  |  |  |  |  |  |                              |   | 10G          |                | 18G                  |
| Operator:   | Eric Lifsey<br>Spurious'Run01'Cha<br>PM, Friday, February      |  | Sm'MHzGHz.til Freq MHz   | Free<br>nsmit, continuous, 2440<br>Range: 2440 MHz<br>Range: 1: 2440 GHz, 2: |  |                              | EUT: 1) Engi<br>Project Numb<br>Client: Avex                                  | ne,2) Remote |                |                      |
|   |  | >  | 1GHz Horizont  | al Antenna F   | Polarity Mea   | sured En                     | nissions  |              |                |                      |

# 8.3.3 Middle Channel Up to 25 GHz

|  |  |  |                | Profess                       | sional Te   | sting, EN                       | ΛI,            | Inc.                   |        |               |                |                 |                   |
|--|--|--|----------------|-------------------------------|---|---------------------------------|----------------|------------------------|--------|---------------|----------------|-----------------|-------------------|
| Test Metho                             | d:   | ANSI C6  | 3.10           |                               |   |                                 |                |                        |        |               |                |                 |                   |
| In accordar                            | nce with:  | FCC Par<br>Limits  | t 15.2         | 09 - Code of F                | ederal Regulat  | ions Part 47, S                 | Subpar         | rt C - Int             | ention | al Radia      | tors, Radiate  | ed Emis         | sions             |
| Section:                               |  | 15.209   |                |                               |   | 1                               |                |                        | _      |               |                |                 |                   |
| Test Date(s                            | s):  |  | 17, 2          | /6/2017                       |   | EUT Serial                      |                |                        |        | , 2: 'B'      |                |                 |                   |
| Customer:                              |  | Avex   |                |                               |   | EUT Part #:                     |                |                        | NA     |               |                |                 |                   |
| Project Nui                            |  | 18717  |                |                               |   | Test Techni                     |                |                        | Eric L |               |                |                 |                   |
| Purchase C                             |  | NA   |                |                               |   | Supervisor:                     |                |                        | Lisa A |               |                |                 |                   |
| Equip. Und                             | er Test:   | 1: Engi  | ine, 2         | : Remote                      |   | Witness' N                      | ame:           |                        | None   |               |                |                 |                   |
|  | R  | Radiate  | d Emi          | issions Test                  | Results Data  | a Sheet                         |                |                        |        | Pag           | e: 1           | of              | 1                 |
| EUT L                                  | ne Voltage:  | •  | 1: 7.2 V,<br>V | 2: 3.0 VDC                    |   | EUT Pow                         | er Fr          | equen                  | cy:    | 0             | N/A            |                 |                   |
| Antenna                                | orientatio   | n:   |                | Vertic                        | al  | Frequ                           | ency           | Range:                 |        |               | Above 1        | GHz             |                   |
| EU                                     | T 1 & 2: Tra   | nsmit F  | requ           | ency 2440 I                   | ИНz   | (                               | Conti          | nuous                  | trans  | mit un        | modulated      | q               |                   |
| Frequency<br>Measured<br>(MHz)         | Test<br>Distance<br>(Meters)   | EU1<br>Direct<br>(Degre  | ion            | Antenna<br>Height<br>(Meters) | Detector<br>Function  | Recorded<br>Amplitude<br>(dBµV) | Le             | ected<br>evel<br>iV/m) | _      | Level<br>V/m) | Margin<br>(dB) | Test I          | Results           |
| 19521.3                                | 3  | 333  | 3              | 1                             | Average   | 32.7                            | 26             | 5.82                   | 54     | 1.0           | -27.1          | Pa              | ass               |
| 21963.3                                | 3  | 299  | 9              | 1                             | Average   | 34.7                            | 29             | .217                   | 54     | 1.0           | -24.7          | Pa              | ass               |
| 24400.7                                | 3  | 219  | 9              | 1                             | Average   | 35.6                            | 31             | .651                   | 54     | 1.0           | -22.3          | Pa              | ass               |
| Radiated                               | sional Testing,<br>Emissions, Measur<br>1z Vertical Polarity Mo  | ed at 1m a   | nd Scale       | d to 3m Distance              |   |                                 |                | — Peak I               |        | ge Reading    |                | PROFES<br>T E S | SIONAL<br>T I N 6 |
| Field Strength (d BpVm) 40             | er og belige state for the best of the bes | report de martine de la constante de la consta | March          |                               |   | V                               | in jekter kete | oletin dida            |        |               |                |                 |                   |
| 20<br>18.0 G<br>Operator:<br>18717'RE' | Eric Lifsey<br>Spurious Run 01 'Chai<br>M. M. Monday , Februai   |  | ) d Bm'M H     | zGHz.til Freq MHz             | Free<br>nsmit, continuous, 2440<br>Range: 2440 MHz<br>ange: 1: 2440 GHz, 2: |                                 |                | Pi                     |        | rine,2) Remo  | te             | 26.             | 5G                |

|                                |  |  |                               | ·  |                                 |                 |                        |  | Ave                        | x LLC   | – Foo  | tbeat E            | ingine          |
|--------------------------------|--|--|-------------------------------|--|---------------------------------|-----------------|------------------------|--|----------------------------|---|--------|--------------------|-----------------|
|                                |  |  | Profess                       | sional Te  | sting, El                       | ΛI,             | Inc.                   |  |                            |   |        |                    |                 |
| Test Metho                     | d:   | ANSI C63.10  |                               |  |                                 |                 |                        |  |                            |   |        |                    |                 |
| In accordan                    | ce with:   | FCC Part 15.   | 209 - Code of I               | ederal Regulat   | ions Part 47,                   | Subpai          | rt C - Int             | ention   | al Radia                   | tors, R   | adiate | d Emiss            | ions            |
| Section:                       |  | 15.209   |                               |  |                                 |                 |                        |  |                            |   |        |                    |                 |
| Test Date(s                    | ):   | 2/3/2017,  | 2/6/2017                      |  | EUT Serial                      | #:              |                        | 1: 'D',  | , 2: 'B'                   |   |        |                    |                 |
| Customer:                      |  | Avex   |                               |  | EUT Part #:                     |                 |                        | NA   |                            |   |        |                    |                 |
| Project Nur                    |  | 18717  |                               |  | Test Techn                      |                 |                        | Eric Li  |                            |   |        |                    |                 |
| Purchase O                     |  | NA   | <u> </u>                      |  | Supervisor:                     |                 |                        | Lisa A   |                            |   |        |                    |                 |
| Equip. Und                     | er Test:   | 1: Engine,   | 2: Remote                     |  | Witness' N                      | ame:            |                        | None   |                            |   |        |                    |                 |
|                                | F  | Radiated En  | nissions Test                 | Results Data   | a Sheet                         |                 |                        |  | Pag                        | e:  | 1      | of                 | 1               |
| EUT Li                         | ne Voltage:  | 1: 7.2 \   | VDC                           |  | EUT Pow                         | ver Fr          | equen                  | су:  | 0                          |   | N/A    |                    |                 |
| Antenna                        | Orientatio   | n:   | Horizon                       | tal  | Frequ                           | ency            | Range:                 |  |                            | Abo   | ve 10  | GHz                |                 |
| EU                             | T 1 & 2: Tra   | nsmit Freq   | uency 2440 I                  | MHz  |                                 | Conti           | nuous                  | transı   | mit un                     | modu  | ılated | l                  |                 |
| Frequency<br>Measured<br>(MHz) | Test<br>Distance<br>(Meters)   | EUT<br>Direction<br>(Degrees)  | Antenna<br>Height<br>(Meters) | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV) | Le              | ected<br>evel<br>iV/m) | Limit<br>(dBµ\   |                            | Mar<br>(di  | U      | Test R             | esults          |
| 19526.7                        | 3  | 4  | 1                             | Average  | 32.7                            | 26              | .813                   | 54   | .0                         | -27   | 7.1    | Pa                 | SS              |
| 21958.6                        | 3  | 319  | 1                             | Average  | 34.7                            | 29              | .224                   | 54   | .0                         | -24   | 1.7    | Pa                 | SS              |
| 24402.8                        | 3  | 151  | 1                             | Average  | 35.6                            | 31              | .668                   | 54   | .0                         | -22   | 2.3    | Pa                 | SS              |
| Radiated                       | ional Testing,<br>Emissions, Measu<br>Iz Horizontal Polarity   | red at 1m and Sca  | led to 3m Distance            |  |                                 |                 | ▽ Correct  — Peak I    | g e Limit Lev<br>cted A v era g<br>Limit Lev el<br>cted Peak R | ge Reading                 |   |        | PROFESS<br>T E S T | SIONAL<br>I N 6 |
| Field Strength (dB w/m) 40     | and the state of t | n difference de la companya de la c |                               | March March March  |                                 | hallande Harton | grade and the same     |  | V                          | or conflict the second |        |                    |                 |
| 30                             |  |  |                               |  |                                 |                 |                        |  |                            |   |        |                    |                 |
| 20±<br>18.0 G                  |  |  | +                             |  |                                 |                 |                        |  | 1                          |   |        | 26.5               | G               |
|                                |  | nMiddle'Pow0dBm'M<br>ry 06,2017  | HzGHz.til Freq MHz            | Free<br>nsmit, continuous, 2440<br>Range: 2440 MHz<br>Range: 1: 2440 GHz, 2: |                                 |                 | Pi                     | UT: 1) Engi<br>roject Numl<br>lient: Avex                      | ine,2) Remot<br>ber: 18717 | te  |        |                    |                 |
|                                |  | > 1G   | Hz Horizont                   | al Antenna F   | olarity Mea                     | sure            | d Emiss                | sions  |                            |   |        |                    |                 |

# 8.3.4 Bottom Channel Up to 18 GHz

|                                |   |   | Profess                       | sional Te  | sting, El  | MI, Inc.   |  |  |                         |
|--------------------------------|---|---|-------------------------------|--|--|--|--|--|-------------------------|
| Test Metho                     | od:   | ANSI C63.10   |                               |  |  |  |  |  |                         |
| n accorda                      | nce with:   | Limits  | 209 - Code of F               | ederal Regulat   | tions Part 47,   | Subpart C - Ir   | ntentional R   | adiators, Ra                                   | diated Emissions        |
| Section:                       | _   | 15.209  |                               |  |  |  |  |  |                         |
| Test Date(s                    | s):   | 2/3/2017,   | 2/6/2017                      |  | EUT Serial   |  | 1: 'D', 2:   | 'B'  |                         |
| Customer:                      | •   | Avex  |                               |  | EUT Part #:  |  | NA   |  |                         |
| Project Nu                     |   | 18717   |                               |  | Test Techn   |  | Eric Lifse   | •  |                         |
| Purchase C                     |   | NA<br>1. Facina (   | ). Damata                     |  | Supervisor   |  | Lisa Arno  | ατ   |                         |
| quip. Und                      | ier rest:   | 1: Engine, 2  | z: Kemote                     |  | Witness' N   | ame:   | None   |  |                         |
|                                | F   |   |                               | Results Dat  | a Sheet  |  |  | Page:  | 1 of 1                  |
| EUT L                          | ine Voltage   | 1: 7.2 V  | VDC                           |  | EUT Pov  | ver Freque   | ncy:   | 0 1  | N/A                     |
| Antenna                        | a Orientatio  | n:  | Vertic                        | al   | Frequ  | ency Range   | 2:   | Abov   | ve 1GHz                 |
| EU                             | T 1 & 2: Tra  | ınsmit Frequ  | uency 2402 I                  | MHz  |  | Continuou  | s transmit   | unmodul  | ated                    |
| Frequency<br>Measured<br>(MHz) | Test Distance (Meters)  | EUT Direction (Degrees)   | Antenna<br>Height<br>(Meters) | Detector<br>Function   | Recorded<br>Amplitude<br>(dBμV)  | Corrected<br>Level<br>(dBµV/m)   | Limit Lev<br>(dBµV/m   | -  | Test Results            |
| 4803.98                        | 3   | 119   | 2.38                          | Average  | 62.8   | 59.129   | 74.0   | -14.   | 9 Pass                  |
| 7205.94                        | 3   | 88  | 3.92                          | Average  | 34.3   | 37.252   | 54.0   | -16.   | 7 Pass                  |
| 9600.7                         | 3   | 58  | 3.67                          | Average  | 26.1   | 34.189   | 54.0   | -19.   | 8 Pass                  |
| 12017.5                        | 3   | 74  | 3.55                          | Average  | 26.1   | 36.444   | 54.0   | -17.   | 5 Pass                  |
| 14406.3                        | 3   | 225   | 1.29                          | Average  | 27.4   | 38.858   | 54.0   | -15.   | 1 Pass                  |
| 16818.8                        | 3   | 150   | 1.68                          | Average  | 27.6   | 40.865   | 54.0   | -13.   | 1 Pass                  |
| Radiated                       | sional Testing,<br>Emissions, 3m Dis<br>Vertical Polarity Measu | tance   |                               |  |  | <ul><li>∇ Cor</li><li>— Pea</li></ul>  | rage Limit Level rected Average Rea s Limit Level rected Peak Readin |  | PROFESSIONAL<br>TESTINS |
| Field Strength (d BµVm)        |   |   |                               |  | <b>+</b>   |  |  | u. dule  |                         |
| 30 - 201G                      |   | A British Control of the Control of |                               | Les de la constitution de la con | of ability and a second leaves of a second leaves o | Antique de la companya de la company | 7  | — <u>—                                    </u> | 18G                     |
| 16                             |   |   |                               | Free   | quency   |  | EUT: 1) Engine,2)  |  | 100                     |

|                                |  |                               |                  |   |                                 |                                | A۱  | ex LLC – Fo    | otbeat Engine           |
|--------------------------------|--|-------------------------------|------------------|---|---------------------------------|--------------------------------|---|----------------|-------------------------|
|                                |  |                               | Profess          | sional Te   | sting, El                       | VII, Inc.                      |   |                |                         |
| Test Metho                     | od:  | ANSI C63.1                    | 0                |   |                                 |                                |   |                |                         |
| n accorda                      | nce with:  | FCC Part 15<br>Limits         | .209 - Code of I | Federal Regula  | tions Part 47,                  | Subpart C - In                 | tentional Rad   | iators, Radiat | ed Emissions            |
| Section:                       |  | 15.209                        |                  |   | T                               |                                |   |                |                         |
| Test Date(                     | s):  | 2/3/2017                      | , 2/6/2017       |   | EUT Serial                      |                                | 1: 'D', 2: 'E   | 3'             |                         |
| Customer:                      |  | Avex                          |                  |   | EUT Part #:                     |                                | NA  |                |                         |
| Project Nu                     |  | 18717                         |                  |   | Test Techn                      |                                | Eric Lifsey   |                |                         |
| Purchase C                     |  | NA                            |                  |   | Supervisor                      |                                | Lisa Arndt  |                |                         |
| Equip. Und                     | ler Test:  | 1: Engine                     | , 2: Remote      |   | Witness' N                      | ame:                           | None  |                |                         |
|                                | F  | Radiated E                    | missions Test    | Results Dat   | a Sheet                         |                                | Pa  | ige: 1         | of 1                    |
| EUT L                          | ine Voltage  | 1: 7.2                        | V, 2: 3.0 VDC    |   | EUT Pov                         | ver Frequei                    | ncy:  | 0 N/A          |                         |
| Antenn                         | a Orientatio   | n:                            | Horizor          | ntal  | Frequ                           | ency Range                     | <b>:</b> :  | Above 1        | .GHz                    |
| EU                             | JT 1 & 2: Tra  | nsmit Free                    | quency 2402      | MHz   |                                 | Continuou                      | s transmit u  | nmodulate      | d                       |
| Frequency<br>Measured<br>(MHz) | Test Distance (Meters)   | EUT<br>Direction<br>(Degrees) | 0                | Detector<br>Function  | Recorded<br>Amplitude<br>(dBµV) | Corrected<br>Level<br>(dBµV/m) | Limit Level<br>(dBµV/m)   | Margin<br>(dB) | Test Results            |
| 4804.04                        | 3  | 54                            | 3.07             | Average   | 70.6                            | 66.896                         | 74.0  | -7.1           | Pass                    |
| 7205.87                        | 3  | 150                           | 2.18             | Average   | 33.8                            | 36.752                         | 54.0  | -17.2          | Pass                    |
| 9590.17                        | 3  | 98                            | 2.32             | Average   | 26.1                            | 34.21                          | 54.0  | -19.7          | Pass                    |
| 12009.3                        | 3  | 58                            | 1.27             | Average   | 26.1                            | 36.435                         | 54.0  | -17.5          | Pass                    |
| 14421.2                        | 3  | 282                           | 2.58             | Average   | 27.5                            | 38.893                         | 54.0  | -15.1          | Pass                    |
| 16824.6                        | 3  | 82                            | 2.31             | Average   | 27.6                            | 40.867                         | 54.0  | -13.1          | Pass                    |
| Radiated                       | ssional Testing,<br>I Emissions, 3m Dis<br>Horizontal Polarity M | tance                         |                  |   |                                 | ▽ Cori                         | rage Limit Level<br>rected Average Readin<br>: Limit Level<br>rected Peak Reading | g              | PROFESSIONAL<br>TESTING |
| Field Strength (dBµVm)         |  |                               |                  |   | V                               |                                | <del></del>   |                |                         |
| nation to                      | nda birasha dhada mara a a dan                                   |                               | plantes distant  | A secretary and the second second                                     |                                 | <u> </u>                       | Y   | <b>Y</b> Y     |                         |
| 30 20 G                        |  |                               |                  |   |                                 |                                | 10G   |                | 18G                     |
| Operator:                      | Eric Lifsey<br>E'Spurious'Run02'Cha                              | nBot'Pow0dBm'GH               |                  | Fre<br>nsmit, continuous, 2402<br>Range: NA<br>Range: 1: 2402 GHz, 2: | quency<br>MHz, power 0 dBm      |                                | EUT: 1) Engine,2) Rei<br>Project Number: 1871                                     |                | 100                     |

# 8.3.5 Bottom Channel Up to 25 GHz

|  |  |                            |           | Profess                       | sional Te  | sting, El                       | ΜI,                | Inc.                    |  |                           |                |                 |         |
|--|--|----------------------------|-----------|-------------------------------|--|---------------------------------|--------------------|-------------------------|--|---------------------------|----------------|-----------------|---------|
| Test Metho   | d:   | ANSI C                     | 63.10     |                               |  |                                 |                    |                         |  |                           |                |                 |         |
| In accordar  | ice with:  | FCC Pa<br>Limits           | rt 15.2   | :09 - Code of F               | ederal Regulat   | ions Part 47, S                 | Subpa              | rt C - Int              | entiona  | al Radia                  | tors, Radiat   | ed Emi          | ssions  |
| Section:   |  | 15.209                     |           |                               |  | 1                               |                    |                         |  |                           |                |                 |         |
| Test Date(s  | ):   | 2/3/2                      | 017, 2    | 2/6/2017                      |  | EUT Serial                      | #:                 |                         | 1: 'D',  | 2: 'B'                    |                |                 |         |
| Customer:  |  | Avex                       |           |                               |  | EUT Part #:                     |                    |                         | NA   |                           |                |                 |         |
| Project Nui  | nber:  | 18717                      | '         |                               |  | Test Techn                      | ician:             |                         | Eric Li  |                           |                |                 |         |
| Purchase O   | rder #:  | NA                         |           |                               |  | Supervisor                      |                    |                         | Lisa A   | rndt                      |                |                 |         |
| Equip. Und   | er Test:   | 1: Enខ្                    | gine, 2   | 2: Remote                     |  | Witness' N                      | ame:               |                         | None   |                           |                |                 |         |
|  | F  | Radiate                    | ed Em     | issions Test                  | Results Data   | a Sheet                         |                    |                         |  | Pag                       | e: 1           | of              | 1       |
| EUT Li   | ne Voltage:  |                            | 1: 7.2 V  |                               |  | EUT Pow                         | ver Fr             | equen                   | су:  | 0                         | N/A            |                 |         |
| Antenna  | Orientatio   | n:                         |           | Vertic                        | al   | Frequ                           | ency               | Range:                  |  |                           | Above 1        | GHz             |         |
| EU   | T 1 & 2: Tra   | nsmit                      | Frequ     | iency 2402 l                  | МНz  |                                 | Conti              | inuous                  | transı   | nit un                    | modulate       | d               |         |
| Frequency<br>Measured<br>(MHz)                                       | Test<br>Distance<br>(Meters)                                   | EU<br>Direc<br>(Degr       | tion      | Antenna<br>Height<br>(Meters) | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV) | Le                 | rected<br>evel<br>uV/m) | Limit I  |                           | Margin<br>(dB) | Test            | Results |
| 19212.1  | 3  | 32                         | 2         | 1                             | Average  | 33.5                            | 27                 | .628                    | 54   | .0                        | -26.3          | P               | ass     |
| 21625.6  | 3  | 12                         | 9         | 1                             | Average  | 34.1                            | 28                 | .229                    | 54   | .0                        | -25.7          | P               | ass     |
| 24019.4  | 3  | 14                         | .9        | 1                             | Average  | 35.1                            | 30                 | .955                    | 54   | .0                        | -23.0          | P               | ass     |
| Radiated   | ional Testing,<br>Emissions, Measur<br>Iz Vertical Polarity Mo | red at 1m                  | and Scal  | ed to 3m Distance             |  |                                 |                    | ∨ Corre                 | ge Limit Lev<br>cted Averag<br>Limit Level<br>cted Peak Ro | e Reading                 |                | PROFES<br>T E S | SIONAL  |
| Field Strength (d B µ V/m) 40 (10 (10 (10 (10 (10 (10 (10 (10 (10 (1 |  | hale and the second of the |           |                               | alan a managan da kanagan da kana | المناسب المعاقبين               | kanasada ja kati l | al territoria           |  |                           |                |                 |         |
| 30   |  | 7                          |           |                               |  |                                 |                    |                         | _ Y  |                           |                |                 |         |
| 20±<br>18.0G   |  |                            |           | +                             | l l  |                                 |                    |                         |  |                           |                | 26              | 5 G     |
|  | Eric Lifsey<br>Spurious'Run02'Chai<br>M, Monday, Februai       |                            | Bm'GHz.ti | l Freq MHz l                  | ısmit, continuous, 2402  |                                 |                    | P                       | UT: 1) Engii<br>roject Numb<br>lient: Avex                 | ne,2) Remot<br>per: 18717 | te             |                 |         |
|  |  |                            | > 10      | GHz Vertica                   | Antenna Po   | larity Meas                     | ured               | Emissi                  | ons  |                           |                |                 |         |

|   |  |                        |                               |  |                                 |  |                          |                 | Ave  | k LLC – Foc                     | tbeat   | Engin   |
|---|--|------------------------|-------------------------------|--|---------------------------------|--|--------------------------|-----------------|--|---------------------------------|---|---------|
|   |  |                        | Profess                       | sional Te  | sting, El                       | ΜI, ∣  | lnc.                     |                 |  |                                 |   |         |
| Test Method:                                    | ANSI   | C63.10                 |                               |  |                                 |  |                          |                 |  |                                 |   |         |
| In accordance w                                 | ith: FCC P   |                        | 09 - Code of F                | ederal Regula  | tions Part 47, S                | Subpar   | t C - Int                | ention          | al Radiat  | ors, Radiate                    | ed Emis   | sions   |
| Section:  | 15.20  | 19                     |                               |  |                                 |  |                          |                 |  |                                 |   |         |
| Test Date(s):                                   | 2/3/   | 2017, 2                | 2/6/2017                      |  | EUT Serial                      | #:   |                          | 1: 'D'          | , 2: 'B'   |                                 |   |         |
| Customer:                                       | Avex   |                        |                               |  | EUT Part #:                     |  |                          | NA              |  |                                 |   |         |
| Project Number:                                 |  | .7                     |                               |  | Test Techn                      |  |                          | Eric Li         |  |                                 |   |         |
| Purchase Order                                  |  |                        |                               |  | Supervisor                      |  |                          | Lisa A          |  |                                 |   |         |
| Equip. Under Te                                 | st: 1: En  | igine, 2               | : Remote                      |  | Witness' N                      | ame:   |                          | None            |  |                                 |   |         |
|   | Radiat   | ted Em                 | issions Test                  | Results Dat  | a Sheet                         |  |                          |                 | Page   | e: 1                            | of  | 1       |
| EUT Line Vo                                     | oltage:  | 1: 7.2 V               | <sup>2: 3.0</sup> VDC         |  | EUT Pow                         | ver Fr   | equen                    | су:             | 0  | N/A                             |   |         |
| Antenna Orie                                    | entation:  |                        | Horizon                       | ıtal   | Frequ                           | ency l   | Range:                   |                 |  | Above 1                         | GHz   |         |
| EUT 1 &   | 2: Transmi   | t Frequ                | ency 2402 I                   | MHz  |                                 | Conti  | nuous                    | trans           | mit uni  | modulate                        | t   |         |
| Measured Dist                                   | ance Dire  | UT<br>ection<br>grees) | Antenna<br>Height<br>(Meters) | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV) | Le   | ected<br>evel<br>eV/m)   | Limit<br>(dBµ\  |  | Margin<br>(dB)                  | Test F  | Results |
| 19207.8   | 3 1  | 53                     | 1                             | Average  | 32.8                            | 26.  | .864                     | 54              | .0   | -27.1                           | Pa  | ass     |
| 21622.3   | 3 2  | 92                     | 1                             | Average  | 34                              | 28.  | .144                     | 54              | .0   | -25.8                           | Pa  | ass     |
| 24017.1   | 3 1  | 83                     | 1                             | Average  | 35                              | 30.  | .829                     | 54              | .0   | -23.1                           | Pa  | ass     |
| Radiated Emission                               | Cesting, EMI, 1<br>ns, Measured at 1n<br>ntalPolarity Measured   | n and Scale            | ed to 3m Distance             |  |                                 |  | — Peak I                 |                 | ge Reading   |                                 | PROFES<br>T E S T   | SIONAL  |
| Field Strength (d Bp Vm)                        | and the state of t | Manadagadadida         |                               | and the state of t |                                 | Mary and a second point of the second point of | a palitation in the same |                 | un de la constitue de la const | Ang (1) Melions desired and and | - Andrews |         |
| 30  |  |                        |                               |  |                                 |  |                          | _ <sub>\_</sub> |  |                                 |   |         |
| 20 <sup>±</sup><br>18.0 G                       |  |                        | 1                             |  |                                 |  |                          |                 |  |                                 | 26.   | 5 G     |
| Operator: Eric Lifsey<br>18717 'R E'Spurious 'I | Run02'ChanBot'Pow<br>lay,February 06,201   |                        | Freq MHz                      | Free<br>nsmit, continuous, 2402<br>Range: NA<br>Range: 1: 2402 GHz, 2:   |                                 |  | Pı                       |                 | ine,2) Remot<br>ber: 18717   | e                               |   |         |
|   |  | > 1GI                  | Hz Horizont                   | al Antenna F   | Polarity Mea                    | sure   | d Emiss                  | ions            |  |                                 |   |         |

# 8.3.6 Top Channel Up to 18 GHz

|                                |  |                            | Profess                       | sional Te  | sting, El                               | MI, I   | nc.                  |   |           |                |                         |
|--------------------------------|--|----------------------------|-------------------------------|--|---|---------|----------------------|---|-----------|----------------|-------------------------|
| Test Metho                     | od:  | ANSI C63.10                |                               |  |   |         |                      |   |           |                |                         |
| In accordar                    | ice with:  | Limits                     | 209 - Code of F               | ederal Regulat   | tions Part 47,                          | Subpar  | t C - Int            | entional  | Radia     | tors, Radiate  | ed Emissions            |
| Section:                       |  | 15.209                     | - 4- 4                        |  | I                                       |         |                      | ·   |           |                |                         |
| Test Date(s                    | 5):  | 2/3/2017,                  | 2/6/2017                      |  | EUT Serial                              |         |                      | 1: 'D',   | 2: 'B'    |                |                         |
| Customer:                      |  | Avex                       |                               |  | EUT Part #:                             |         |                      | NA  |           |                |                         |
| Project Nui                    |  | 18717                      |                               |  | Test Techn                              |         |                      | Eric Lif  |           |                |                         |
| Purchase O                     |  | NA                         |                               |  | Supervisor                              |         |                      | Lisa Ar   | ndt       |                |                         |
| Equip. Und                     | er Test:   | 1: Engine,                 | 2: Remote                     |  | Witness' N                              | ame:    |                      | None  |           |                |                         |
|                                | F  |                            |                               | Results Data   | a Sheet                                 |         |                      |   | Pag       | e: 1           | of 1                    |
| EUT Li                         | ne Voltage:  | 1: 7.2 \                   | VDC                           |  | EUT Pov                                 | ver Fre | equen                | cy:   | 0         | N/A            |                         |
| Antenna                        | Orientatio   | n:                         | Vertic                        | al   | Frequ                                   | ency F  | Range:               |   |           | Above 1        | GHz                     |
| EU                             | T 1 & 2: Tra   | nsmit Freq                 | uency 2480 I                  | MHz  |   | Conti   | nuous                | transn  | nit un    | modulated      | ł                       |
| Frequency<br>Measured<br>(MHz) | Test<br>Distance<br>(Meters)                                   | EUT Direction (Degrees)    | Antenna<br>Height<br>(Meters) | Detector<br>Function   | Recorded<br>Amplitude<br>(dBμV)         | Le      | ected<br>vel<br>V/m) | Limit L<br>(dBµV  |           | Margin<br>(dB) | Test Results            |
| 4959.97                        | 3  | 121                        | 2.25                          | Average  | 65                                      | 61.     | 813                  | 74.   | 0         | -12.2          | Pass                    |
| 7426.23                        | 3  | 254                        | 2.99                          | Average  | 28.6                                    | 32.     | 246                  | 54.   | 0         | -21.7          | Pass                    |
| 9912.81                        | 3  | 133                        | 3.54                          | Average  | 26.6                                    | 34.     | 465                  | 54.   | 0         | -19.5          | Pass                    |
| 12395.4                        | 3  | 155                        | 3.5                           | Average  | 27                                      | 37.     | 783                  | 54.   | 0         | -16.2          | Pass                    |
| 14876.8                        | 3  | 218                        | 3.13                          | Average  | 28.3                                    | 39      | .86                  | 54.   | 0         | -14.1          | Pass                    |
| 17357.8                        | 3  | 204                        | 2.6                           | Average  | 26.5                                    | 39      | .02                  | 54.   | 0         | -14.9          | Pass                    |
| Radiated<br>1-18GHz V<br>90    | sional Testing,<br>Emissions, 3m Dis<br>ertical Polarity Measu | tance                      |                               |  |   |         | ∨ Corre              | ge Limit Leve<br>cted Average<br>Limit Level<br>cted Peak Rea | Reading   |                | PROFESSIONAL<br>TESTING |
| Field Strength (d Bµ Vm        |  |                            |                               | los de 15 de de la companya esta                                       | V I I I I I I I I I I I I I I I I I I I |         |                      |   | V V       | <u>ү</u> ү     |                         |
| 30<br>20<br>1 G                |  |                            |                               |  |   |         | Y                    |   | 0 G       |                | 18G                     |
| Operator: 18717 RE             |  | nTopPow0dBm'GHz<br>03,2017 | til Freq MHz                  | Freq<br>nsmit, continuous, 2480<br>Range: NA<br>Range: 1: 2480 GHz, 2: |   |         | P                    | UT: 1) Engine<br>roject Numbe                                 | e,2) Remo | te             | 190                     |

|                                     |  |                                     |  |                               |  |  |               | _                      |  | Ave                                   | x LLC – Fo     | otbeat E   | ngine  |
|-------------------------------------|--|-------------------------------------|--|-------------------------------|--|--|---------------|------------------------|--|---------------------------------------|----------------|------------|--------|
|                                     |  |                                     |  | Profess                       | sional Te  | sting, El  | ΜI,           | Inc.                   |  |                                       |                |            |        |
| Test Metho                          | od:  | ANSI C                              | 3.10   |                               |  |  |               |                        |  |                                       |                |            |        |
| n accorda                           | nce with:  | FCC Par<br>Limits                   | t 15.2   | 09 - Code of F                | ederal Regulat   | tions Part 47, S                                       | Subpai        | rt C - Int             | entiona  | l Radia                               | tors, Radia    | ted Emiss  | ions   |
| Section:                            |  | 15.209                              |  |                               |  | •  |               |                        | _  |                                       |                |            |        |
| Test Date(s                         | s):  | 2/3/20                              | 17, 2  | 2/6/2017                      |  | EUT Serial   | #:            |                        | 1: 'D',  | 2: 'B'                                |                |            |        |
| Customer:                           |  | Avex                                |  |                               |  | EUT Part #:  |               |                        | NA   |                                       |                |            |        |
| Project Nu                          |  | 18717                               |  |                               |  | Test Techn   |               |                        | Eric Li  |                                       |                |            |        |
| Purchase C                          | order #:   | NA                                  |  |                               |  | Supervisor:  |               |                        | Lisa A   | rndt                                  |                |            |        |
| Equip. Und                          | ler Test:  | 1: Eng                              | ine, 2   | 2: Remote                     |  | Witness' N   | ame:          |                        | None   |                                       |                |            |        |
|                                     | F  | Radiate                             | d Em   | issions Test                  | Results Data   | a Sheet  |               |                        |  | Pag                                   | ge: 1          | of         | 1      |
| EUT L                               | ine Voltage  |                                     | 1: 7.2 V<br>V  | VDC                           |  | EUT Pow  | ver Fr        | equen                  | су:  | 0                                     | N/A            | 1          |        |
| Antenn                              | a Orientatio   | n:                                  |  | Horizon                       | ntal   | Frequ  | ency          | Range:                 |  |                                       | Above :        | lGHz       |        |
| EU                                  | T 1 & 2: Tra   | nsmit I                             | requ   | iency 2480 I                  | MHz  |  | Conti         | nuous                  | transn   | nit un                                | modulate       | ed         |        |
| Frequency<br>Measured<br>(MHz)      | Test Distance (Meters)   | EU <sup>*</sup><br>Direct<br>(Degre | ion  | Antenna<br>Height<br>(Meters) | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV)                        | Le            | ected<br>evel<br>iV/m) | Limit L<br>(dBµV   |                                       | Margin<br>(dB) | Test Re    | esults |
| 4959.99                             | 3  | 56                                  |  | 2.87                          | Average  | 71.7   | 68            | .514                   | 74.  | 0                                     | -5.5           | Pas        | SS     |
| 7439.99                             | 3  | 80                                  |  | 2.23                          | Average  | 31.2   | 34            | .896                   | 54.  | 0                                     | -19.1          | Pas        | SS     |
| 9921.93                             | 3  | 234                                 | 1  | 1.35                          | Average  | 26.5   | 3.            | 4.4                    | 54.  | 0                                     | -19.6          | Pas        | SS     |
| 12401.5                             | 3  | 336                                 | ĵ  | 1.57                          | Average  | 27.1   | 37            | .822                   | 54.  | 0                                     | -16.1          | Pas        | SS     |
| 14890.1                             | 3  | 228                                 | 3  | 1.29                          | Average  | 28.3   | 39            | .955                   | 54.  | 0                                     | -14.0          | Pas        | ss     |
| 17348.7                             | 3  | 352                                 | 2  | 3.05                          | Average  | 26.6   | 38            | .991                   | 54.  | 0                                     | -15.0          | Pas        | SS     |
| Radiated                            | sional Testing,<br>Emissions, 3m Dis<br>Horizontal Polarity Mo   | tance                               |  |                               |  |  |               | ∨ Corre                | ge Limit Leve<br>cted Average<br>Limit Level<br>cted Peak Re | Reading                               |                | PROFESSION |        |
| Field Strength (d B µ V/m)  00  104 |  |                                     |  |                               |  | V  | -<br> -<br> - |                        |  | -                                     |                |            |        |
| 30 - 30                             | a delicate d | markethia dhe san lagari            | A Part of the latest t | Makabahaha dan persahahan     | A Company of the Comp | la bay saway sayaba a da | Jest de La    | <u> </u>               |  | \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ | <u> </u>       | 7          |        |
| 20 E                                |  |                                     |  |                               |  |  |               |                        | 1  | 10G                                   |                | 18G        |        |
| Operator:<br>18717 'RE              | Eric Lifsey<br>'Spurious'Run03'Cha<br>PM, Friday, February   | •                                   | Bm'GHz.ti  | il Freq MHz                   | Free<br>nsmit, continuous, 2480<br>Range: NA<br>Range: 1: 2480 GHz, 2:   |  |               | P                      | UT: 1) Engin<br>roject Numbo<br>lient: Avex                  | e, 2) Remo                            | te             |            |        |
|                                     |  |                                     | > 1GI  | Hz Horizont                   | al Antenna F   | Polarity Mea   | sure          | d Emis                 | sions  |                                       |                |            |        |

# 8.3.7 Top Channel Up to 25 GHz

|                                |  |  | Profess                       | sional Te               | sting, El                       | MI, Inc.   |  |           |  |              |        |
|--------------------------------|--|--|-------------------------------|-------------------------|---------------------------------|--|--|-----------|--|--------------|--------|
| Test Metho                     | od:  | ANSI C63.1   | 0                             |                         |                                 |  |  |           |  |              |        |
| n accorda                      | nce with:  | FCC Part 15<br>Limits  | .209 - Code of I              | Federal Regula          | tions Part 47,                  | Subpart C - Int                                  | tentional F  | Radiators | , Radiate  | d Emis       | sions  |
| Section:                       |  | 15.209   |                               |                         |                                 |  |  |           |  |              |        |
| Test Date(                     | s):  | 2/3/2017   | 2/6/2017                      |                         | EUT Serial                      | #:   | 1: 'D', 2  | : 'B'     |  |              |        |
| Customer:                      |  | Avex   |                               |                         | EUT Part #                      |  | NA   |           |  |              |        |
| Project Nu                     |  | 18717  |                               |                         | Test Techn                      | ician:   | Eric Lifs  |           |  |              |        |
| Purchase C                     |  | NA   |                               |                         | Supervisor                      |  | Lisa Arn   | dt        |  |              |        |
| quip. Und                      | ler Test:  | 1: Engine,   | 2: Remote                     |                         | Witness' N                      | ame:   | None   |           |  |              |        |
|                                | F  | Radiated E   | missions Test                 | : Results Dat           | a Sheet                         |  |  | Page:     | 1  | of           | 1      |
| EUT L                          | ine Voltage  | 1: 7.2   | V, 2: 3.0 VDC                 |                         | EUT Pov                         | ver Frequen                                      | icy:   | 0         | N/A  |              |        |
| Antenn                         | a Orientatio   | n:   | Vertic                        | al                      | Frequ                           | Frequency Range: Above 1GF                       |  |           | GHz  |              |        |
| EU                             | T 1 & 2: Tra   | nsmit Fred   | uency 2480                    | MHz                     |                                 | Continuous                                       | transmi  | t unmo    | dulated  | i            |        |
| Frequency<br>Measured<br>(MHz) | Test<br>Distance<br>(Meters)   | EUT<br>Direction<br>(Degrees)  | Antenna<br>Height<br>(Meters) | Detector<br>Function    | Recorded<br>Amplitude<br>(dBµV) | Corrected<br>Level<br>(dBµV/m)                   | Limit Le <sup>-</sup><br>(dBμV/                                      | _         | largin<br>(dB)   | Test F       | Result |
| 19830                          | 3  | 47   | 1                             | Average                 | 32.8                            | 27.059   | 54.0   | -         | 26.9   | Pa           | ass    |
| 22309.3                        | 3  | 95   | 1                             | Average                 | 34.3                            | 29.125   | 54.0   | -         | 24.8   | Pa           | ass    |
| 24809.3                        | 3  | 95   | 1                             | Average                 | 36.1                            | 32.352   | 54.0   |           | 21.6   | Pa           | ass    |
| Radiated                       | sional Testing,<br>Emissions, Measu<br>Hz Vertical Polarity M  | red at 1m and Sc   | aled to 3m Distance           |                         |                                 | ▽ Corre — Peak                                   | age Limit Level<br>ected Average R<br>Limit Level<br>ected Peak Read |           |  | PROFES:      |        |
| Field Strength (dBp.Vm) 200    | The state of the s | an and the land of | Y                             |                         | or policy like the control of   | ne gedenski presidenski de Blistone.<br>Romanija |  |           | at the late of the | مروان والدان |        |
| 20 ± 18.0 G Operator:          | Eric Lifsey<br>'Spurious'Run03'Cha   | n Ton Pow ûd Rm'C H  |                               | nsmit, continuous, 2480 | quency<br>MHz, po wer 0 dBm     |  | EUT: 1) Engine, 2  |           |  | 26.5         | 5 G    |
| 18717 RE                       | Spurious Runos Cha   | n rop rowoubm Gr   | Freq MHz                      |                         |                                 | -  | roject ramber.   | 10/1/     |  |              |        |

|                                |  |                               |                               | ·  |  |             |  |  | Ave                                      | x LLC -     | - Foo  | tbeat E            | ingine        |
|--------------------------------|--|-------------------------------|-------------------------------|--|--|-------------|--|--|--|-------------|--|--------------------|---------------|
|                                |  |                               | Profess                       | sional Te  | sting, El  | MI, I       | lnc.                                       |  |  |             |  |                    |               |
| Test Metho                     | d:   | ANSI C63.10                   |                               |  |  |             |  |  |  |             |  |                    |               |
| In accordar                    | ice with:  | FCC Part 15.2<br>Limits       | 209 - Code of F               | ederal Regulat   | ions Part 47,  | Subpar      | t C - Int                                  | ention   | al Radiat                                | ors, Ra     | adiate   | d Emiss            | ions          |
| Section:                       |  | 15.209                        |                               |  |  |             |  |  |  |             |  |                    |               |
| Test Date(s                    | ):   | 2/3/2017,                     | 2/6/2017                      |  | EUT Serial   |             |  | _  | , 2: 'B'                                 |             |  |                    |               |
| Customer:                      |  | Avex                          |                               |  | EUT Part #:  |             |  | NA   |  |             |  |                    |               |
| Project Nur                    |  | 18717                         |                               |  | Test Techn   |             |  | Eric Li  |  |             |  |                    |               |
| Purchase O                     |  | NA<br>1. Facina (             | ). Dameta                     |  | Supervisor   |             |  | Lisa A   |  |             |  |                    |               |
| Equip. Und                     | er rest:   | 1: Engine, 2                  | z: Kemote                     |  | Witness' N   | ame:        |  | None   |  |             |  |                    |               |
|                                | F  | Radiated Em                   | issions Test                  | Results Data   | a Sheet  |             |  |  | Page                                     | e:          | 1  | of                 | 1             |
| EUT Li                         | ne Voltage:  | 1: 7.2 V                      | VDC                           |  | EUT Pov  | ver Fr      | equen                                      | су:  | 0  | 1           | N/A  |                    |               |
| Antenna                        | Orientatio   | n:                            | Horizon                       | tal  | Frequ  | ency l      | Range:                                     |  |  | Abo         | ve 10  | Hz                 |               |
| EU                             | T 1 & 2: Tra   | ınsmit Frequ                  | iency 2480 l                  | MHz  |  | Conti       | nuous                                      | trans  | mit unı                                  | modu        | lated  |                    |               |
| Frequency<br>Measured<br>(MHz) | Test<br>Distance<br>(Meters)                                 | EUT<br>Direction<br>(Degrees) | Antenna<br>Height<br>(Meters) | Detector<br>Function   | Recorded<br>Amplitude<br>(dBµV)  | Le          | ected<br>vel<br>V/m)                       | Limit<br>(dBµ\   |  | Marg<br>(dB | •  | Test R             | esults        |
| 19835.8                        | 3  | 157                           | 1                             | Average  | 32.6   | 26.         | 883  | 54   | .0                                       | -27.        | .1   | Pa                 | ss            |
| 22324.9                        | 3  | 104                           | 1                             | Average  | 34.3   | 29.         | 163  | 54   | .0                                       | -24.        | .8   | Pa                 | SS            |
| 24799.9                        | 3  | 108                           | 1                             | Average  | 36.1   | 32.325 54.0 |  | .0   | -21.                                     | .6          | Pa   | SS                 |               |
| Radiated<br>18-26.5 GH<br>90   | ional Testing,<br>Emissions, Measu<br>Iz Horizontal Polarity | red at 1m and Scal            | ed to 3m Distance             |  |  |             | <ul><li>∇ Corre</li><li>— Peak l</li></ul> | g e Limit Le<br>cted Avera<br>Limit Level<br>cted Peak F   | g e R ea ding                            |             |  | PROFESS<br>T E S T | SIONAL<br>N 6 |
| Field Strength (d Bp V m) 30   |  | <u> </u>                      |                               | adan paralam larakan   | And the state of t |             | apatie <sup>a</sup> khanta                 | , the contract of the contract | J. J |             | Jaguer de participat de la constantina della con | 26.5               | s.c           |
| Operator: 1<br>18717 RES       |  |                               | Freq MHz<br>Freq GHz          | nsmit, continuous, 2480<br>Range: NA<br>Range: 1: 2480 GHz, 2: | 2480 GHz   |             | P  | roject Num<br>lient: Avex  | tine,2) Remotester: 18717                | te          |  |                    |               |
|                                |  | > 1G                          | Hz Horizont                   | al Antenna F   | Polarity Mea   | surec       | l Emiss                                    | sions  |  |             |  |                    |               |

### 9.0 Mains Conducted Emission

### 9.1 Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor and 0.4 meters from the conductive reference plane (wall). The EUT is powered through a line impedance stabilization network (LISN) that provides a measurement tap and a termination approximating 50 Ohms in the measurement range of 150 kHz to 30 MHz. A spectrum analyzer is connected, in turn, to each mains line measurement tap and software is employed to measure the radio frequency noise generated by the EUT.

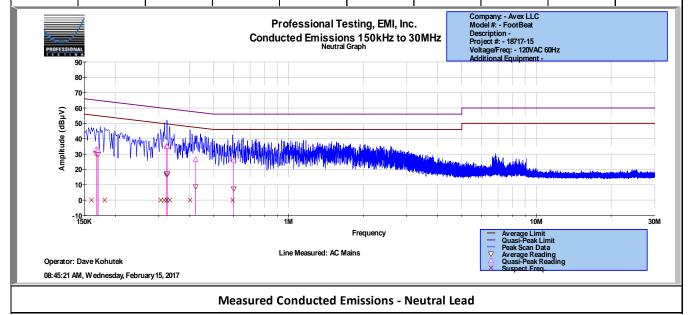
### 9.2 Criteria

| 47 CFR (USA) // IC (Canada) |                             |              |  |  |  |  |  |
|-----------------------------|-----------------------------|--------------|--|--|--|--|--|
| Section Reference           | Parameter                   | Date(s)      |  |  |  |  |  |
| 15.207 //                   | Mains Conducted Emission    | 3 Mar 2017   |  |  |  |  |  |
| RSS-Gen 8.3                 | Wallis Colladeted Ellission | 3 14101 2017 |  |  |  |  |  |

### 9.3 Results

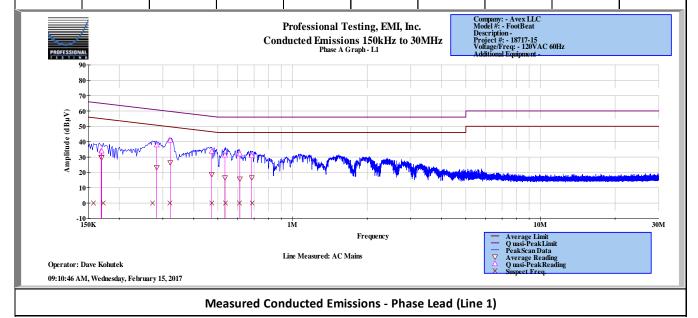
| Professional Testing, EMI, Inc.  |           |                  |                                |  |  |  |  |  |
|--|-----------|------------------|--------------------------------|--|--|--|--|--|
| Test Method:  ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38). |           |                  |                                |  |  |  |  |  |
| In accordance with:  FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions  Limits   |           |                  |                                |  |  |  |  |  |
| Section:   | 15.107    |                  |                                |  |  |  |  |  |
| Test Date(s):  | 2/15/2017 | EUT Serial #:    | Pre-Production Sample 12/19/16 |  |  |  |  |  |
| Customer:  | Avex LLC  | EUT Part #:      | None                           |  |  |  |  |  |
| Project Number:  | 18717-15  | Test Technician: | Dave Kohutek                   |  |  |  |  |  |
| Purchase Order #:  | 1001      | Supervisor:      | Lisa Arndt                     |  |  |  |  |  |
| Equip. Under Test:   | FootBeat  | Witness' Name:   | None                           |  |  |  |  |  |

|                                | Conducted Emissions Test Results Data Sheet - Neutral Lead P |                                    |                                  |                                 |   |  |  |                                       |  |  |
|--------------------------------|--|------------------------------------|----------------------------------|---------------------------------|---|--|--|---------------------------------------|--|--|
| EU                             | EUT Line Voltage:  |                                    |                                  | VAC                             | EUT                                       | Line Freque                              | ncy:                                   | 60                                    | Hz                                     |  |
| Frequency<br>Measured<br>(MHz) | Peak Detector Reading (dBµV)                                 | Quasi-peak Detector Reading (dBµV) | Quasi-peak Detector Limit (dBµV) | Quasi-peak Detector Margin (dB) | Quasi-peak<br>Detector<br>Test<br>Results | Average<br>Detector<br>Reading<br>(dBµV) | Average<br>Detector<br>Limit<br>(dBµV) | Average<br>Detector<br>Margin<br>(dB) | Average<br>Detector<br>Test<br>Results |  |
| 0.16757                        | 39.1   | 33                                 | 65.1                             | -32.1                           | PASS                                      | 30.2                                     | 55.1                                   | -24.9                                 | PASS                                   |  |
| 0.17042                        | 38.1   | 32.5                               | 64.9                             | -32.4                           | PASS                                      | 29.7                                     | 54.9                                   | -25.2                                 | PASS                                   |  |
| 0.32264                        | 42.5   | 35.3                               | 59.6                             | -24.4                           | PASS                                      | 17.2                                     | 49.6                                   | -32.4                                 | PASS                                   |  |
| 0.32295                        | 42.6   | 35.1                               | 59.6                             | -24.6                           | PASS                                      | 16.4                                     | 49.6                                   | -33.3                                 | PASS                                   |  |
| 0.32365                        | 42.5   | 35                                 | 59.6                             | -24.6                           | PASS                                      | 16.9                                     | 49.6                                   | -32.7                                 | PASS                                   |  |
| 0.3237                         | 42.5   | 34.9                               | 59.6                             | -24.7                           | PASS                                      | 17.2                                     | 49.6                                   | -32.4                                 | PASS                                   |  |
| 0.42204                        | 35   | 26.5                               | 57.4                             | -30.9                           | PASS                                      | 8.7                                      | 47.4                                   | -38.7                                 | PASS                                   |  |
| 0.60128                        | 34.2   | 26.1                               | 56                               | -29.9                           | PASS                                      | 7.3                                      | 46                                     | -38.7                                 | PASS                                   |  |
|                                |  | 1                                  |                                  | 1                               |   |  |  |                                       |  |  |



|  |           |                  | S .                            |  |  |  |  |  |
|--|-----------|------------------|--------------------------------|--|--|--|--|--|
| Professional Testing, EMI, Inc.  |           |                  |                                |  |  |  |  |  |
| Test Method:  ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38). |           |                  |                                |  |  |  |  |  |
| In accordance with:  FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Conducted Emissions Limits  |           |                  |                                |  |  |  |  |  |
| Section:   | 15.107    |                  |                                |  |  |  |  |  |
| Test Date(s):  | 2/15/2017 | EUT Serial #:    | Pre-Production Sample 12/19/16 |  |  |  |  |  |
| Customer:  | Avex LLC  | EUT Part #:      | None                           |  |  |  |  |  |
| Project Number:  | 18717-15  | Test Technician: | Dave Kohutek                   |  |  |  |  |  |
| Purchase Order #:  | 1001      | Supervisor:      | Lisa Arndt                     |  |  |  |  |  |
| Equip. Under Test:   | FootBeat  | Witness' Name:   | None                           |  |  |  |  |  |

|                                | Conducted Emissions Test Results Data Sheet - Phase Lead (Line 1) Pa |                                    |   |  |   |  |  |                                       |  |  |
|--------------------------------|--|------------------------------------|---|--|---|--|--|---------------------------------------|--|--|
| EUT Line Voltage:              |  |                                    | 120                                       | VAC                                      | EUT                                       | Line Freque                              | ncy:                                   | 60                                    | Hz                                     |  |
| Frequency<br>Measured<br>(MHz) | Peak Detector Reading (dBµV)   | Quasi-peak Detector Reading (dBµV) | Quasi-peak<br>Detector<br>Limit<br>(dBµV) | Quasi-peak<br>Detector<br>Margin<br>(dB) | Quasi-peak<br>Detector<br>Test<br>Results | Average<br>Detector<br>Reading<br>(dBµV) | Average<br>Detector<br>Limit<br>(dBµV) | Average<br>Detector<br>Margin<br>(dB) | Average<br>Detector<br>Test<br>Results |  |
| 0.16924                        | 39.6   | 34                                 | 65  | -31                                      | PASS                                      | 29.9                                     | 55                                     | -25.1                                 | PASS                                   |  |
| 0.16986                        | 39.7   | 33.8                               | 65  | -31.1                                    | PASS                                      | 29.7                                     | 55                                     | -25.2                                 | PASS                                   |  |
| 0.28328                        | 40.7   | 37.7                               | 60.7                                      | -23                                      | PASS                                      | 23.2                                     | 50.7                                   | -27.5                                 | PASS                                   |  |
| 0.32123                        | 43.3   | 40.9                               | 59.7                                      | -18.8                                    | PASS                                      | 26.3                                     | 49.7                                   | -23.3                                 | PASS                                   |  |
| 0.47208                        | 36.7   | 33.6                               | 56.5                                      | -22.9                                    | PASS                                      | 18.7                                     | 46.5                                   | -27.8                                 | PASS                                   |  |
| 0.53416                        | 36.6   | 31.2                               | 56  | -24.8                                    | PASS                                      | 16.6                                     | 46                                     | -29.4                                 | PASS                                   |  |
| 0.61328                        | 35.4   | 32                                 | 56  | -24                                      | PASS                                      | 15.8                                     | 46                                     | -30.2                                 | PASS                                   |  |
| 0.68466                        | 34.5   | 30.8                               | 56  | -25.2                                    | PASS                                      | 16.5                                     | 46                                     | -29.5                                 | PASS                                   |  |



### **10.0** Antenna Construction Requirements

### 10.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users.

### 10.2 Criteria

| 47 CFR (USA) // IC (Canada) |                      |            |  |  |  |  |  |  |
|-----------------------------|----------------------|------------|--|--|--|--|--|--|
| Section Reference           | Parameter            | Date(s)    |  |  |  |  |  |  |
| 15.203 //<br>RSS-Gen 8.3    | Antenna Construction | 3 Mar 2017 |  |  |  |  |  |  |

### 10.3 Results

| Table 10.3.1 Antenna Construction Details                            |                 |                      |  |  |  |  |  |
|--|-----------------|----------------------|--|--|--|--|--|
| Manufacturer: Johanson Technology http://www.johansontechnology.com/ |                 |                      |  |  |  |  |  |
|  | Part Number     | 2450AT18A100         |  |  |  |  |  |
|  | Frequency Range | 2400 - 2500 Mhz      |  |  |  |  |  |
|  | Peak Gain       | 0.5 dBi typ. (XZ-V)  |  |  |  |  |  |
|  | Average Gain    | -0.5 dBi typ. (XZ-V) |  |  |  |  |  |

- Antenna is chip style component soldered to the circuit board.
- The UF.L connector used for conducted measurements is not present in the finished product.
- Peak gain is 0.5 dBi.

The antenna design above satisfies the requirements of the rules.

# 11.0 Equipment

### 11.1 Radiated Emissions 30 MHz to 25 GHz

| 11.1 K  | auiateu Eillissi      |                              | 25 GHZ   |                |                         |
|---------|-----------------------|------------------------------|--|----------------|-------------------------|
|         |                       | Radiate                      | ed Emissions Test Equipment List                                       |                |                         |
| Ti      | ile! Software Version | on: 4.2.A,                   | , May 23, 2010, 08:38:52 AM  |                |                         |
|         | Test Profile:         |                              | RE_ClassA - Boresite+Mast_LowPRF_<br>RE_ClassB - Boresite+Mast_LowPRF_ |                |                         |
| Asset # | Manufacturer          | Model                        | Equipment Nomenclature   | Serial Number  | Calibration<br>Due Date |
| 1509A   | Braden                | N/A                          | TDK 10M Chamber, NSA < 1 GHz   | DAC-012915-005 | 7/10/2017               |
| 1890    | HP                    | 8447F                        | Preamp/Amp, 9kHz-1300MHz,<br>28/25dB                                   | 3313A05298     | 2/1/2018                |
| 1937    | Agilent               | E4440A                       | Spectrum Analyzer, 3 Hz - 26.5 GHz,<br>Opt. AYZ                        | MY44808298     | 11/15/2017              |
| 1926    | ETS-Lindgren          | 3142D                        | Antenna, Biconilog, 26 MHz - 6 GHz                                     | 135454         | 1/25/2017               |
| C027D   | PTI                   | None                         | Relay  | none           | N/A                     |
| 1327    | EMCO                  | 1050                         | Controller, Antenna Mast   | none           | N/A                     |
| 0942    | EMCO                  | 11968D                       | Turntable, 4ft.  | 9510-1835      | N/A                     |
| 1969    | HP                    | 11713A                       | Attenuator/Switch Driver   | 3748A04113     | N/A                     |
|         |                       |                              |  |                | <u> </u>                |
| 1509B   | Braden                | N/A                          | TDK 10M Chamber, VSWR > 1 GHz  | DAC-012915-005 | 6/19/2017               |
| 2004    | Miteq                 | AFS44-00101800-<br>2S-10P-44 | Amplifier, 40dB, .1-18GHz  | 0              | 1/11/2018               |
| C030    | none                  | none                         | Cable Coax, N-N, 30m   | none           | 10/1/2017               |
| 1325    | EMCO                  | 1050                         | Controller, Antenna Mast   | 9003-1461      | N/A                     |
| 1780    | ETS-Lindgren          | 3117                         | Antenna, Double Ridged Guide<br>Horn, 1 - 18 GHz                       | 110313         | 2/25/2017               |
|         |                       |                              |  |                | I                       |
| 1937    | Agilent               | E4440A                       | Spectrum Analyzer, 3 Hz - 26.5 GHz,<br>Opt. AYZ                        | MY44808298     | 11/15/2017              |
| 1542    | A.H. Systems          | SAS-572                      | Antenna, Horn 18-26.5GHz, 20dB<br>gain                                 | 225            | 11/20/2018              |
|         |                       |                              |  |                | <br>                    |

Amplifier, Microwave 0.5-26.5 GHz

83017A

11/17/2018

MY39500497

1973

Agilent

## 11.2 Bandwidth

| Asset # | Manufacturer | Model # | Description       | Calibration<br>Due |
|---------|--------------|---------|-------------------|--------------------|
| 2295    | Agilent      | E4440A  | Spectrum Analyzer | 30 Sep 2017        |

### 11.1 Duty Cycle

| Asset # | Manufacturer | Model # | Description                       | Calibration<br>Due |
|---------|--------------|---------|-----------------------------------|--------------------|
| None    | ETS          | None    | Shielded Test Enclosure           | CNR                |
| 0472    | Tektronix    | THS730A | DMM/Scope                         | 15 Nov 2017        |
| 1974    | Agilent      | 83017A  | Microwave Amplifier               | CNR                |
| None    | Pasternack   | None    | Diode Detector                    | CNR                |
| None    | PTI          | None    | 2 GHz Sleeve Dipole Sense Antenna | CNR                |
| None    | Various      | None    | Coaxial Cables, RG type           | CNR                |

## 11.1 Mains Conducted Emission

|         | Conducted Emissions Test Equipment List                             |             |                                    |               |                         |  |
|---------|---|-------------|------------------------------------|---------------|-------------------------|--|
| Til     | Tile! Software Version: 4.1.A.0, April 14, 2009, 11:01:00PM         |             |                                    |               |                         |  |
|         | Test Profile: CE_2015_TILE4_Ver2_100616.TIL or CE_Marine_100616.TIL |             |                                    |               |                         |  |
| Asset # | Manufacturer  | Model       | Equipment Nomenclature             | Serial Number | Calibration<br>Due Date |  |
| 1145    | НР  | 8568B       | Spectrum Analyzer 100Hz-1.5GHz     | 2517A01821    | 7/20/2017               |  |
| 1834    | НР  | 85662A      | Spec Anal Dsply, use with A/N 1145 | 2349A06182    | N/A                     |  |
| 0990    | НР  | 85685A      | RF Preselector                     | 3010A01119    | 7/20/2017               |  |
| 0085    | НР  | 85650A      | Quasi-Peak Adapter CISPR           | 3033A01458    | 7/20/2017               |  |
| 1173    | PTI   | 100k HPF    | Filter, High Pass, 100kHz          | none          | 2/2/2018                |  |
| 1088    | PTI   | PTI-ALF4    | Attenuator Limiter Filter          | none          | 10/6/2017               |  |
| C171    | НР  | 08444-60018 | Cable, RF, BNC-BNC, 18", Grey      | none          | 6/13/2018               |  |
| C303    | Coleman Cable   | RG-58A/U    | Cable, BNC-BNC, 36" Black          | None          | 3/25/2018               |  |
| C107    | Pomona  | RG-223      | Cable 9 ft BNC RG-223 (black)      | none          | 8/4/2018                |  |
| 1185    | EMCO  | 3825/2      | LISN, 10kHz-100MHz                 | 1235          | 8/1/2017                |  |

### 12.0 Measurement Bandwidths

| Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan |                              |                         |                          |                            |
|---|------------------------------|-------------------------|--------------------------|----------------------------|
| Frequency Band Start<br>(MHz)   | Frequency Band Stop<br>(MHz) | 6 dB Bandwidth<br>(kHz) | Number of<br>Ranges Used | Measurement Time per Range |
| 0.009   | 0.15                         | 0.3                     | 2                        | Multiple Sweeps            |
| 0.15  | 30                           | 9                       | 6                        | Multiple Sweeps            |
| 30  | 1000                         | 120                     | 2                        | Multiple 800 mS Sweeps     |
| 1000  | 6000                         | 1000                    | 2                        | Multiple Sweeps            |
| 6000  | 18000                        | 1000                    | 2                        | Multiple Sweeps            |
| 18000   | 26500                        | 1000                    | 2                        | Multiple Sweeps            |

#### \*Notes:

- 1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.
- 2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.
- 3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.
- 4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.
- 5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

| Conducted Emissions Spectrum Analyzer Bandwidth and Measurement Time |                              |                         |                          |                               |
|--|------------------------------|-------------------------|--------------------------|-------------------------------|
| Frequency Band Start<br>(MHz)  | Frequency Band Stop<br>(MHz) | 6 dB Bandwidth<br>(kHz) | Number of<br>Ranges Used | Measurement Time per<br>Range |
| 0.01   | 0.15                         | 0.3                     | 7                        | Five 1 second sweeps          |
| 0.15   | 30                           | 9                       | 20                       | Five 1 second sweeps          |

#### \*Notes

- 1. The settings above are specifically calculated for the HP856X series of spectrum analyzers, which have 1,000 data points per range.
- 2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 10-150 kHz.
- 3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.

### Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

### 1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

**Table 1: Summary of Measurement Uncertainties for Site 45** 

| Type of Measurement         | Frequency Range   | Meas. Dist. | Expanded<br>Uncertainty<br>U, dB (k=2) |
|-----------------------------|-------------------|-------------|--|
| Mains Conducted Emissions   | 150 kHz to 30 MHz | N/A         | 2.9                                    |
| Telecom Conducted Emissions | 150 kHz to 30 MHz | N/A         | 2.8                                    |
| Radiated Emissions          | 30 to 1,000 MHz   | 10 m        | 4.8                                    |
|                             | 1 to 18 GHz       | 3 m         | 5.7                                    |

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