Project 18717A-15

Avex LLC
Footbeat Engine

Wireless Certification Report

Prepared for:

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120 W. Park Drive Suite #205
Grand Junction, CO 81505

By

Professional Testing (EMI), Inc.
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23 Mar 2017

Reviewed by	Written by
	
Larry Finn Chief Technical Officer	Eric Lifsey EMC Engineer

Revision History

Revision Number	Description	Date
00	Draft 04 for review.	24 Mar 2017
01	Final.	29 Mar 2017

Corrections:

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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, 2400-2483.5 MHz, 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 Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-247	Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-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)

*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.

Eric Lifsey
EMC Engineer

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.

_____
Representative 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 Model: Engine	none	2400-2483.5 MHz FHSS transceiver; using Bluetooth Low Energy radio protocols.

Table 1.2.2: Support Equipment		
Manufacturer / Model	**Serial #**	**Description**
Avex LLC 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:

Raw Measured Level + Attenuator Factor + Cable Losses = Corrected Level

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 Subpart C -Intentional Radiators
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-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 Wireless Devices

Table 1.7.2: Applicable Clauses

Parameter	FCC Part 15 Rule Paragraphs	IC RSS References
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
15.247(a)(3) // RSS-247 5.2	Fundamental Power Conducted Limits 1 W Limit Restated as Field: 125.23 dBµV/m @ 3 m	2 Feb 2017

2.3 Test Results, Peak Power

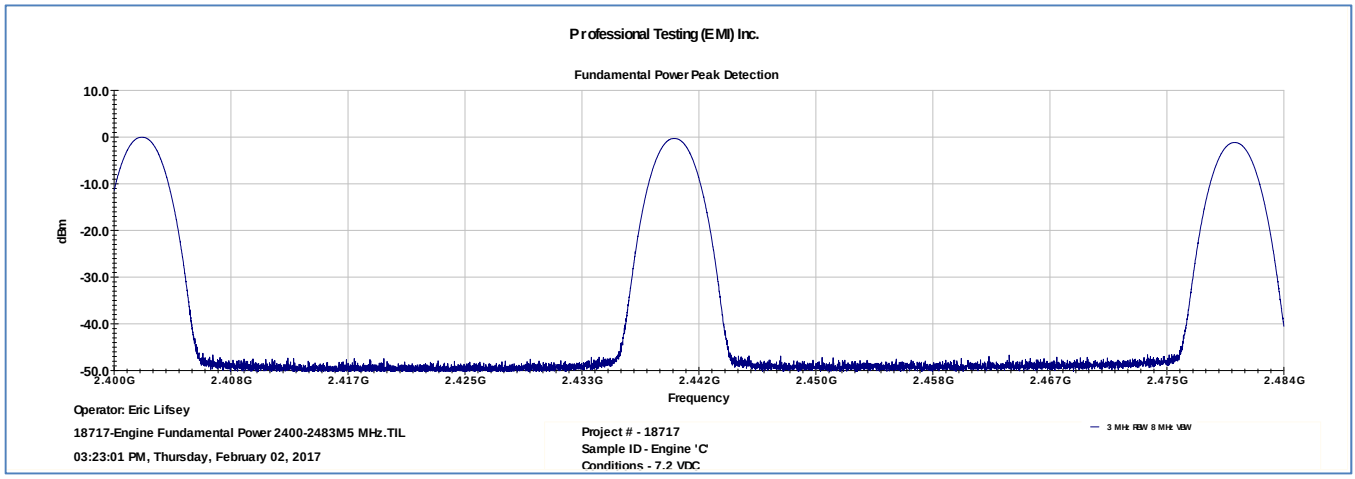
The EUT was measured for conducted power by connection directly to a spectrum analyzer.

Table 2.3.1 Power, Peak, Conducted

Frequency MHz	Measured Peak Power in dBm	Measured Peak Power 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.

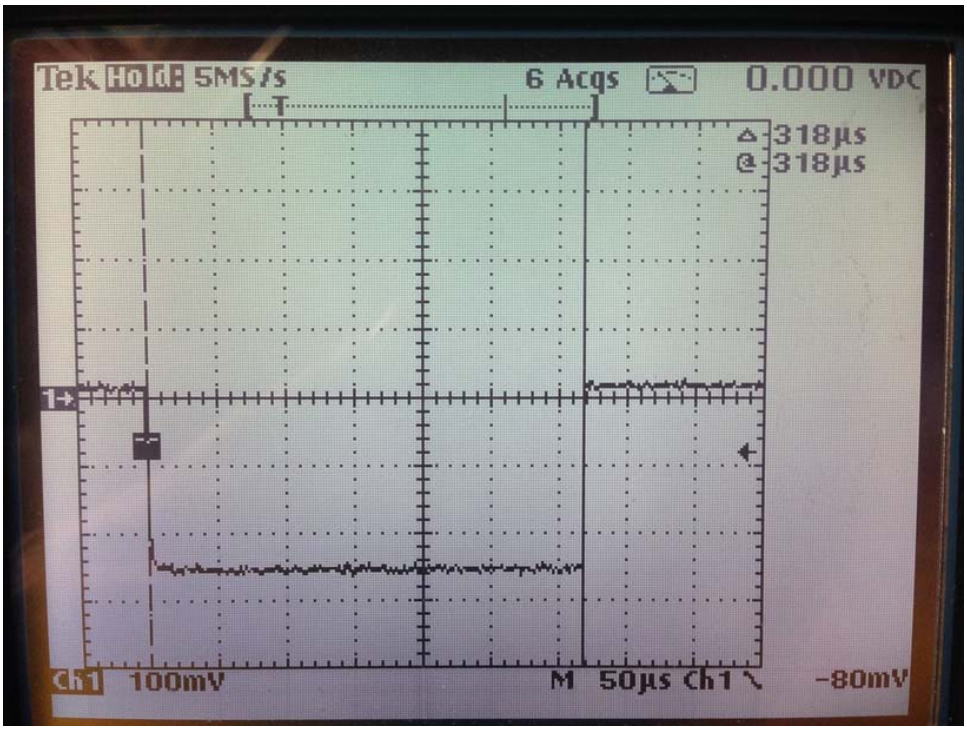
A detector diode, laboratory RF amplifier, and oscilloscope was used for this measurement.

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

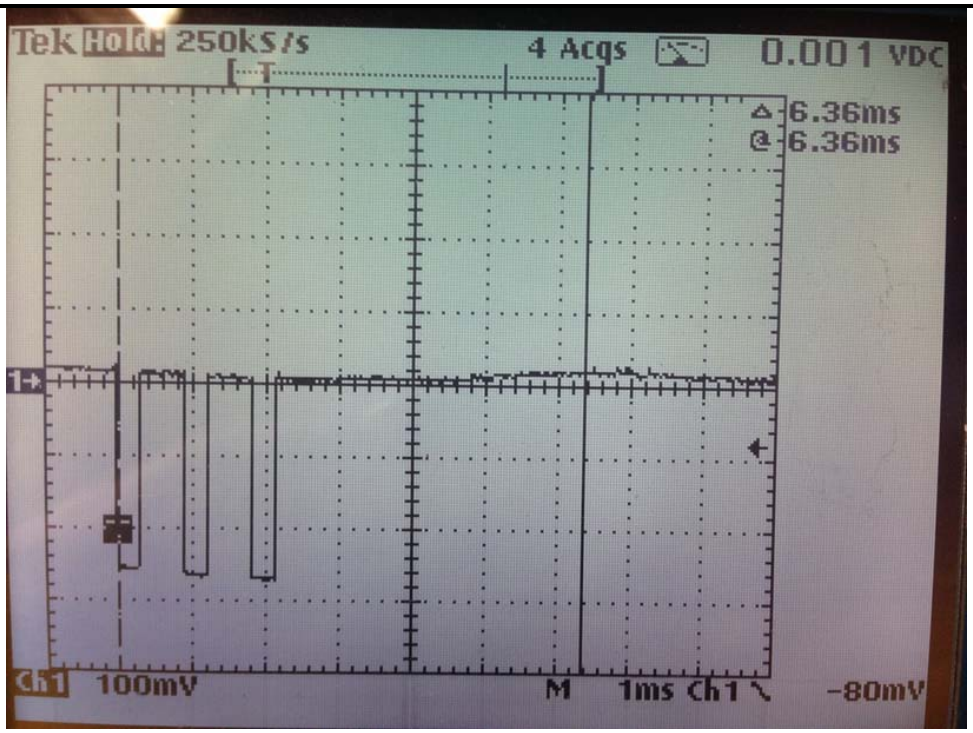
Table 2.5.1 Duty Cycle Results and Average Duty Cycle Factor Result				
Total Measured On Time (msec)	**Measured Time Interval (msec)**	**Duty Cycle Factor Calculation**	**Result (dB)**	**Duty Cycle Factor Allowed (dB)**
0.318 X 3 = 0.954	100	= 20 * Log_{10} (0.954 msec / 100 msec)	-40	-20

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

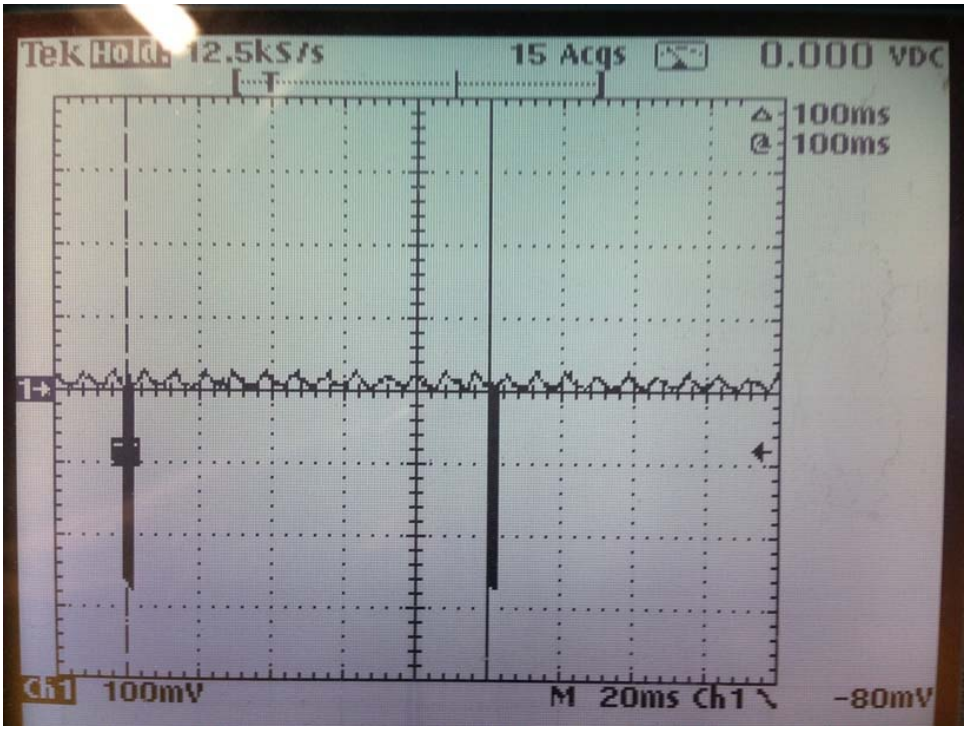
Plotted results appear below.



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 Limit: 8 dBm / 3 kHz Restated as field strength limit: 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 // 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.

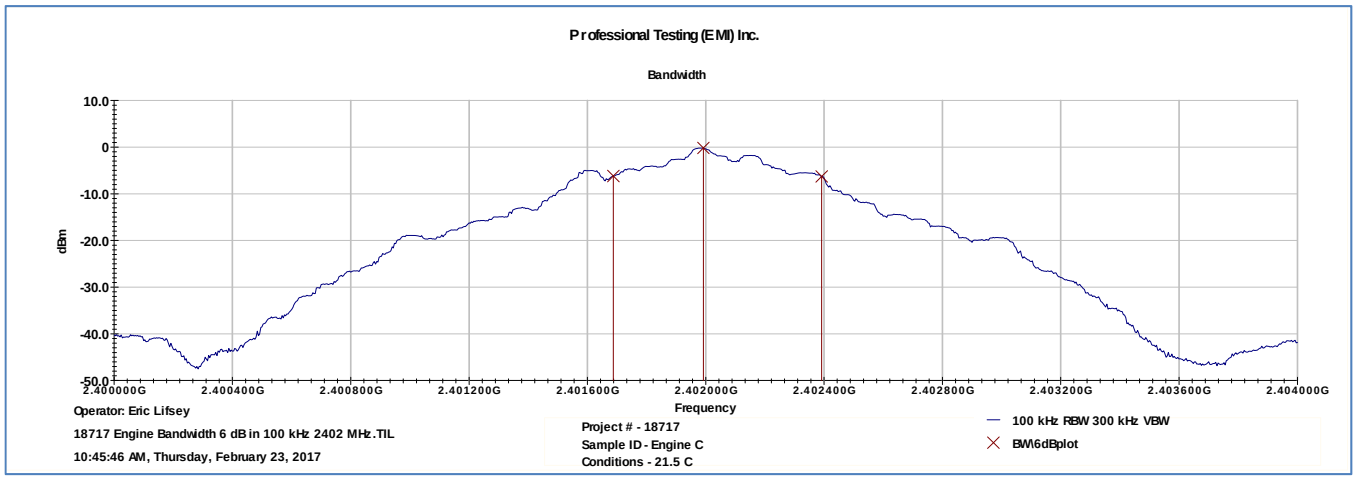
The EUT was found to be in compliance with applicable requirements.

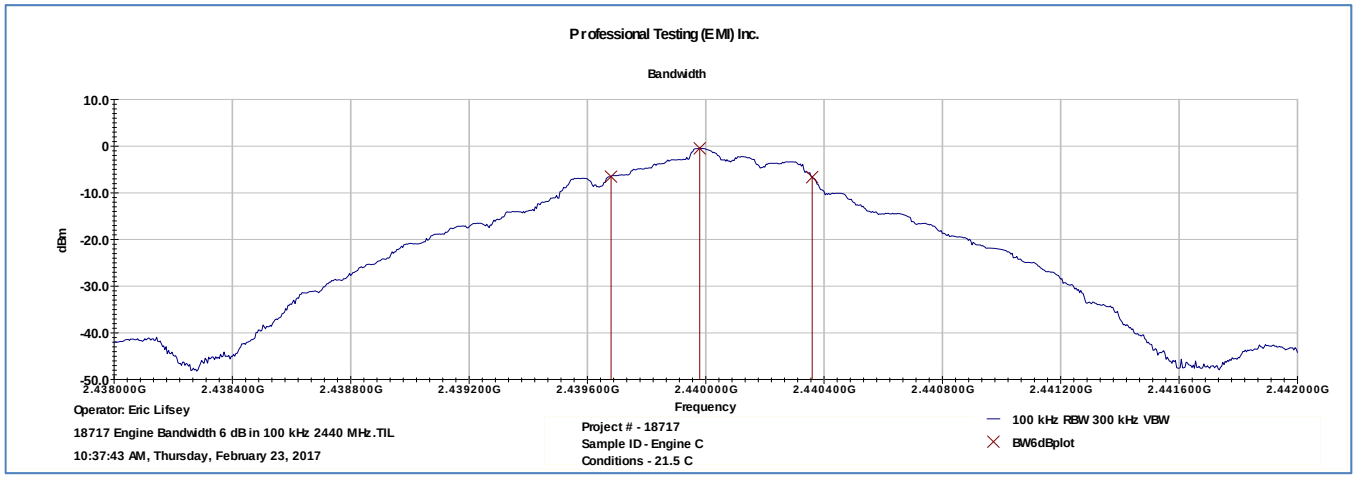
Table 5.3.1 Bandwidth 6 dB, Minimum 500 kHz in 100 kHz RBW			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Minimum BW (kHz)**
704	680	668	**668**

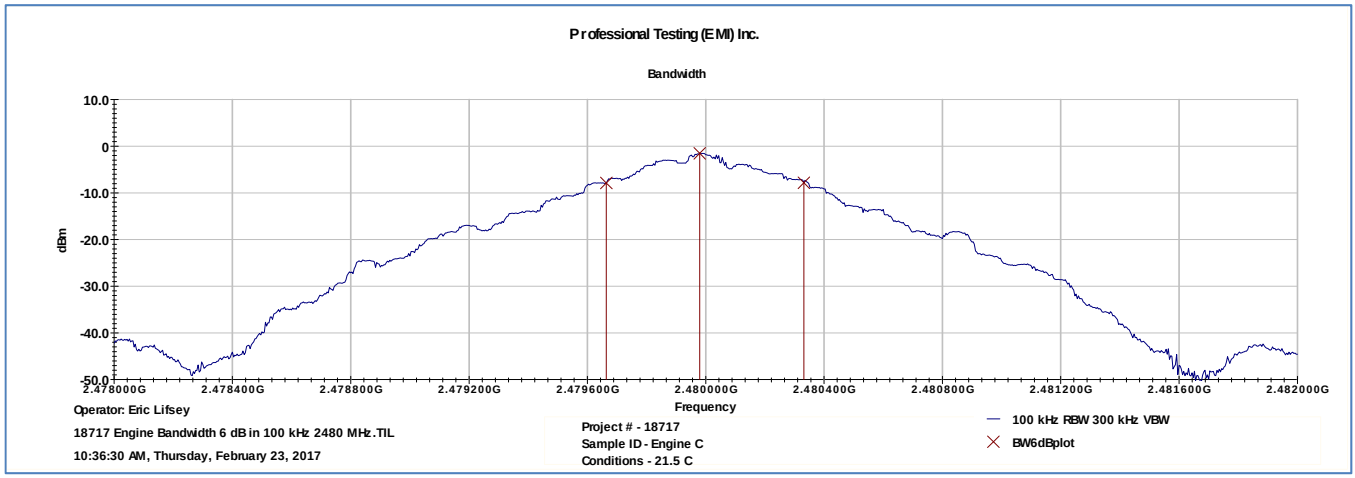
Table 5.3.2 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	**Reported Maximum BW (kHz)**
1472	1472	1528	**1528**

Plotted measurements appear on the following pages.

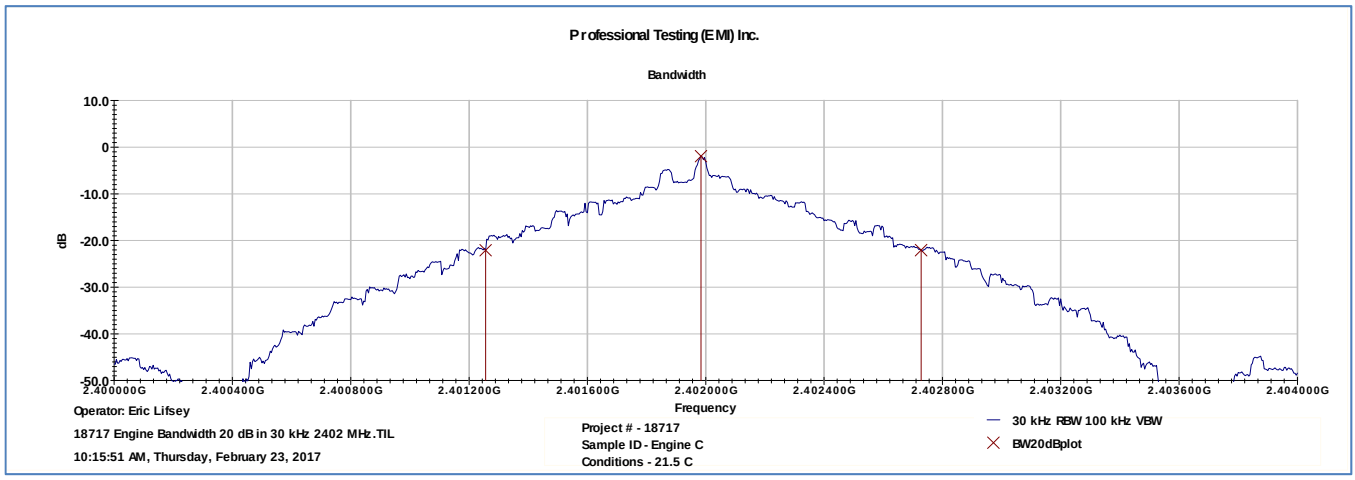
4.3.1 Bandwidth Plots, 6 dB

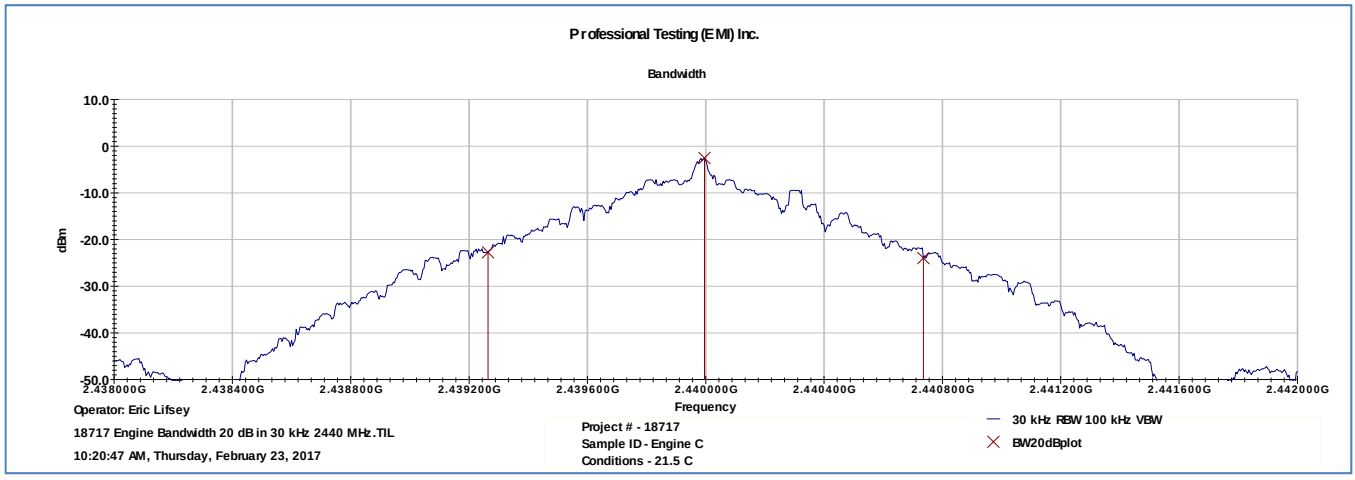


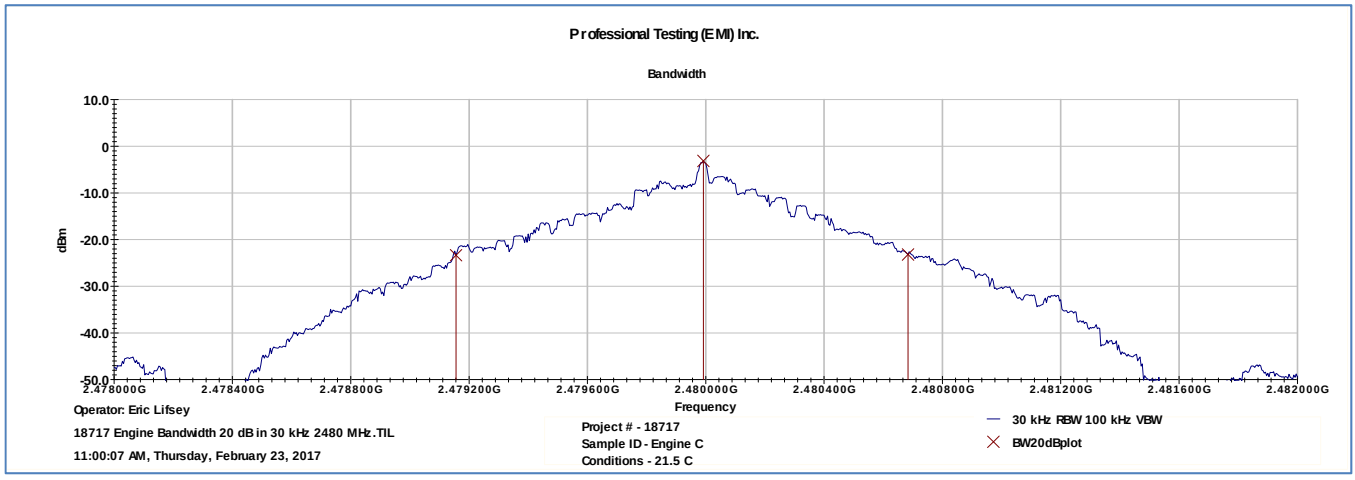




4.3.2 Bandwidth Plots, 20 dB







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 // RSS-247 5.5, RSS-Gen 4.9	Unwanted Emissions Adjacent to Authorized Band, Radiated	23 Feb 2017

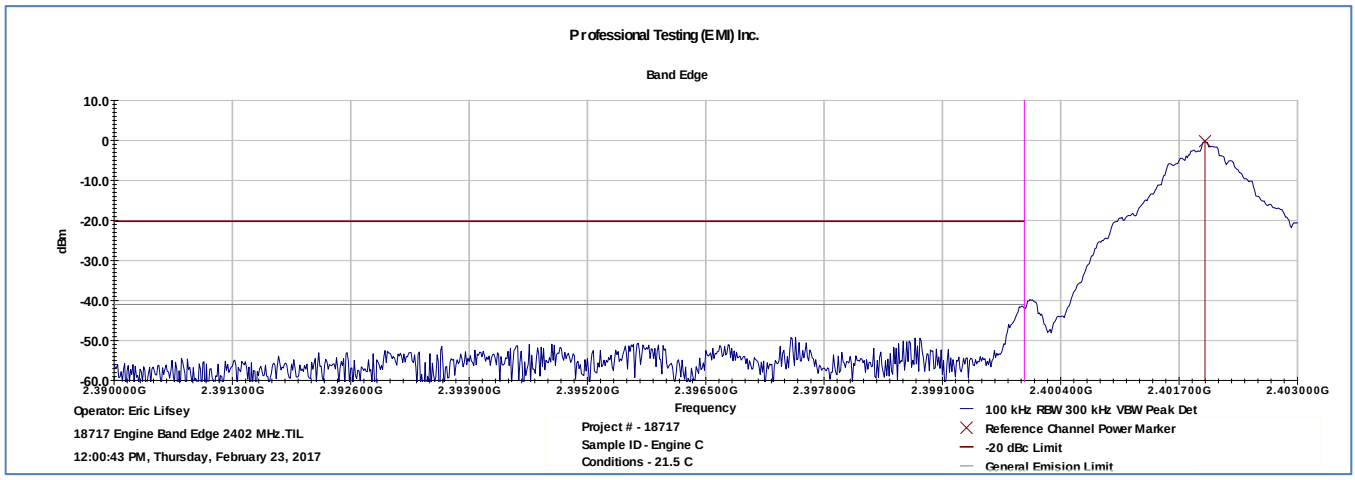
5.3 Test Results

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

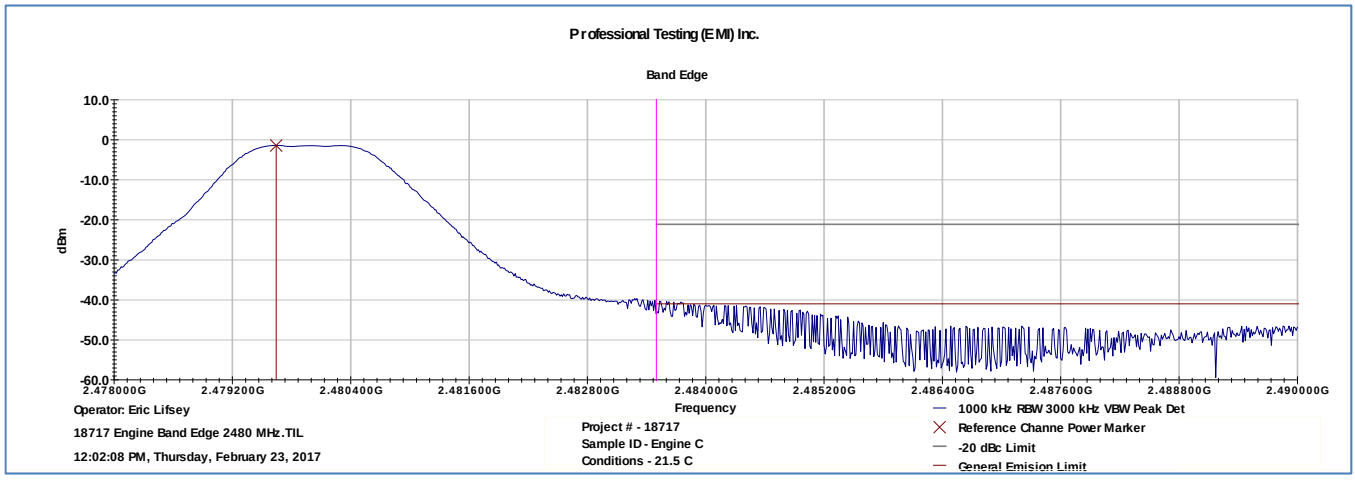
The EUT satisfied the criteria. Plotted results of peak detection appear on the following pages.

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



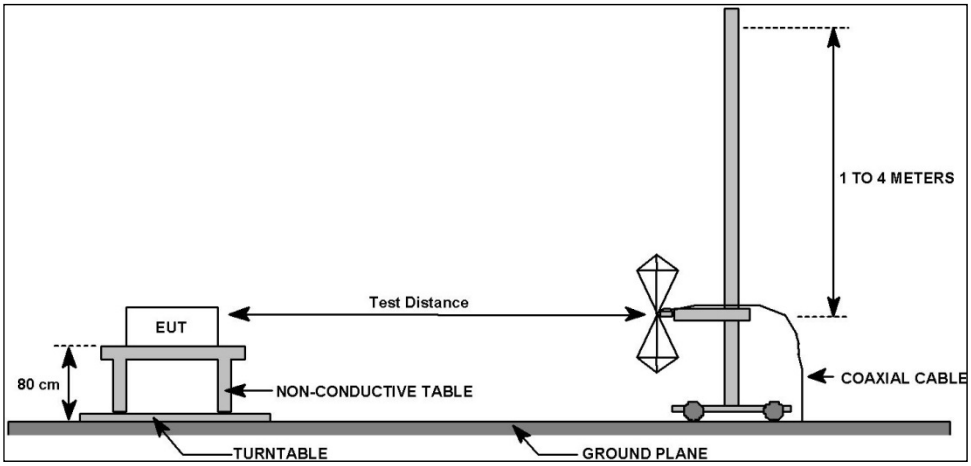
Peak detection is employed while the general emission limits for average and peak levels are shown. The applicable duty cycle factor is -20 dB.

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 // 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.

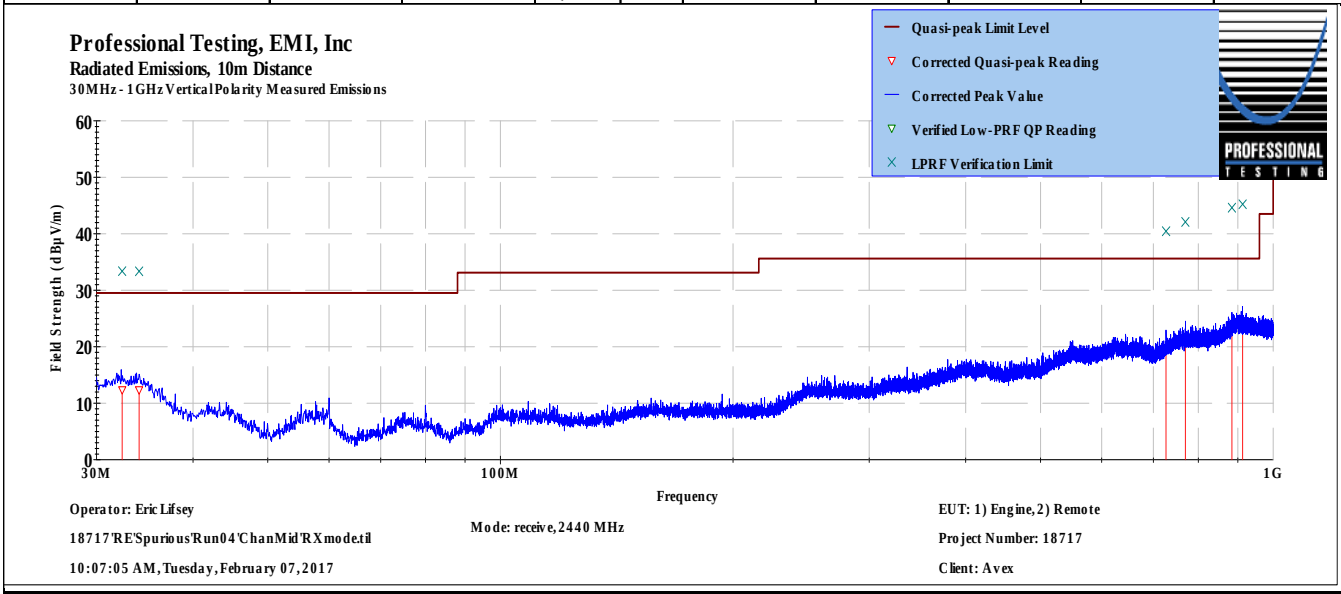
The EUT satisfied the criteria. Recorded data is presented below.

6.3.1 Up to 1 GHz

Professional Testing, EMI, Inc.			
Test Method:	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):	2/7/2017	EUT Serial #:	1: 'D', 2: 'B'
Customer:	Avex	EUT Part #:	NA
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 V VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT 1 & 2: Receive Frequency 2440 MHz		Continuous receive	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	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



≤ 1GHz Vertical Antenna Polarity Measured Emissions

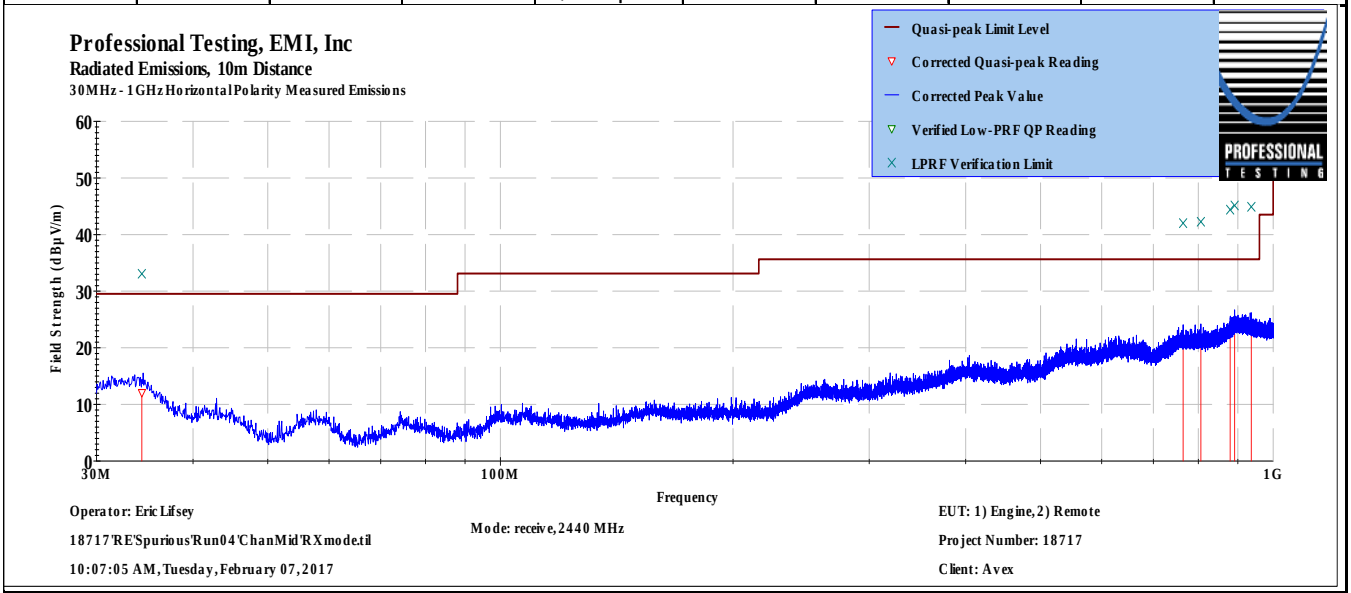
Professional Testing, EMI, Inc.

Test Method:	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):	2/7/2017	**EUT Serial #:**	1: 'D', 2: 'B'
Customer:	Avex	**EUT Part #:**	NA
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 V VDC	**EUT Power Frequency:**	0	N/A	
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz		
EUT 1 & 2: Receive Frequency 2440 MHz		**Continuous receive**			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
34.3452	10	44	3.94	Quasi-peak	23.7	12.062	29.5	-17.4	Pass
764.765	10	208	3.57	Quasi-peak	21.6	21.021	35.6	-14.6	Pass
806.244	10	144	1.87	Quasi-peak	21.4	21.257	35.6	-14.3	Pass
879.978	10	336	1.4	Quasi-peak	21.3	23.398	35.6	-12.2	Pass
891.731	10	82	3.69	Quasi-peak	21.3	24.122	35.6	-11.5	Pass
937.33	10	345	1.26	Quasi-peak	21.1	23.892	35.6	-11.7	Pass



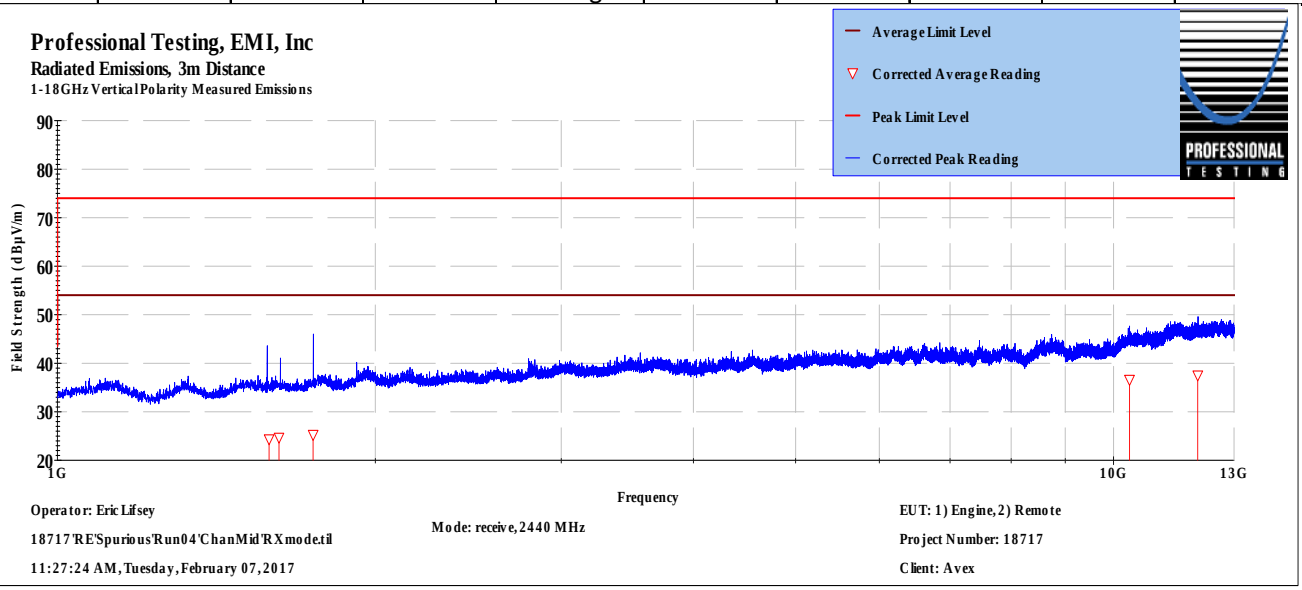
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 Up to 13 GHz

Professional Testing, EMI, Inc.			
Test Method:	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):	2/7/2017	EUT Serial #:	1: 'D', 2: 'B'
Customer:	Avex	EUT Part #:	NA
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 V VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT 1 & 2: Receive Frequency 2440 MHz		Continuous receive	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (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



> 1GHz Vertical Antenna Polarity Measured Emissions

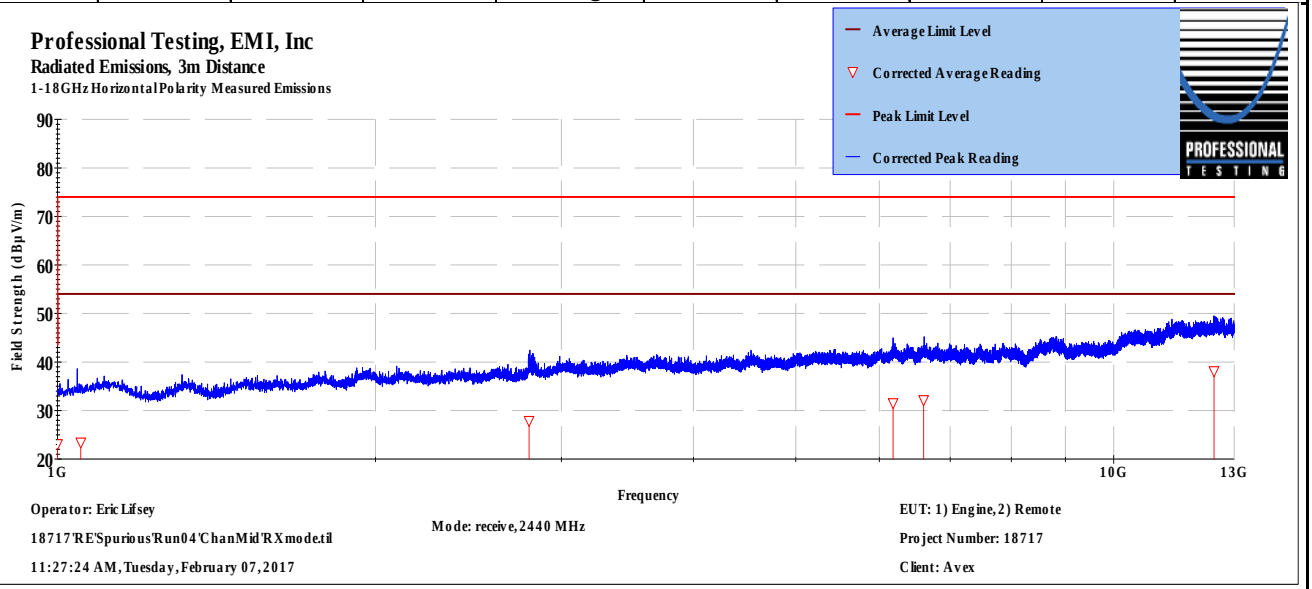
Professional Testing, EMI, Inc.

Test Method:	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):	2/7/2017	**EUT Serial #:**	1: 'D', 2: 'B'
Customer:	Avex	**EUT Part #:**	NA
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 V VDC	**EUT Power Frequency:**	0	N/A	
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz		
EUT 1 & 2: Receive Frequency 2440 MHz		**Continuous receive**			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1000.24	3	133	1.12	Average	34.5	23.119	74.0	-50.9	Pass
1052.45	3	98	3.86	Average	35	23.437	54.0	-30.5	Pass
2795.63	3	276	1.53	Average	35.5	27.887	54.0	-26.1	Pass
6181.39	3	51	3.65	Average	31.4	31.565	54.0	-22.4	Pass
6607.93	3	109	3.88	Average	30.5	32.152	54.0	-21.8	Pass
12442.7	3	60	2.02	Average	27.4	38.135	54.0	-15.8	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

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 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Spurious/Harmonic Emissions Transmit Mode	2 Feb 2017

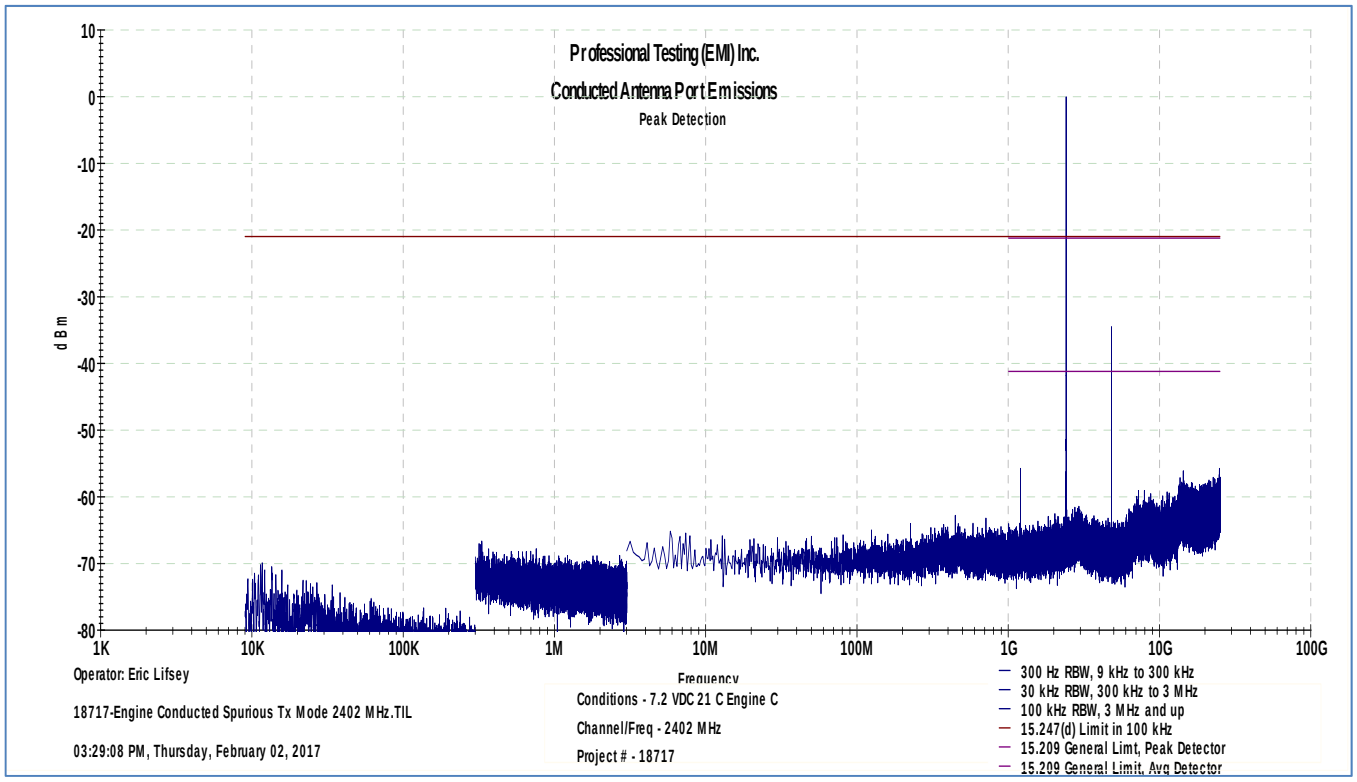
7.3 Test Results

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

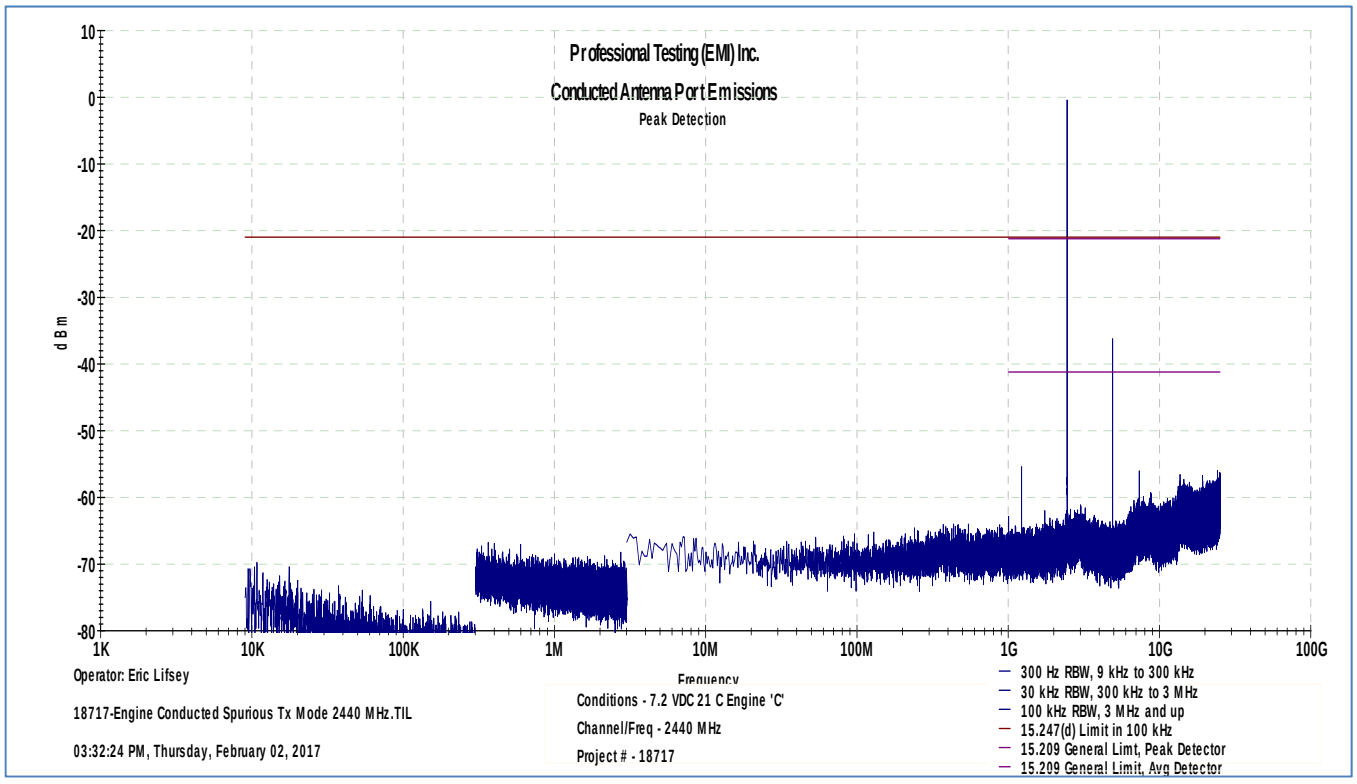
The duty cycle averaging factor applies -20.0 dB to the peaks recorded for the harmonics. Since the peak measurement satisfied the peak limit with margin, the average emission would equally satisfy the average limit.

All measurements used peak detection.

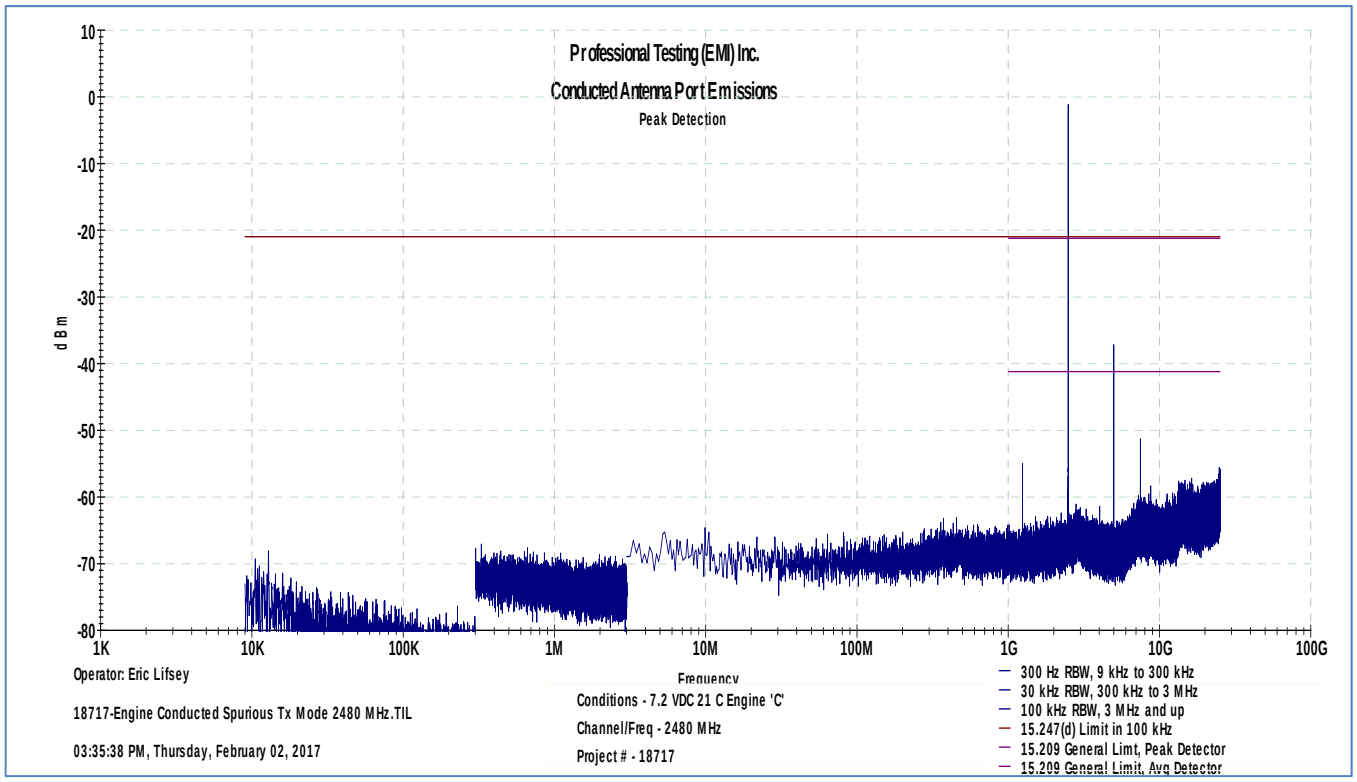
7.3.1 Bottom Channel



7.3.2 Middle Channel



7.3.3 Top Channel

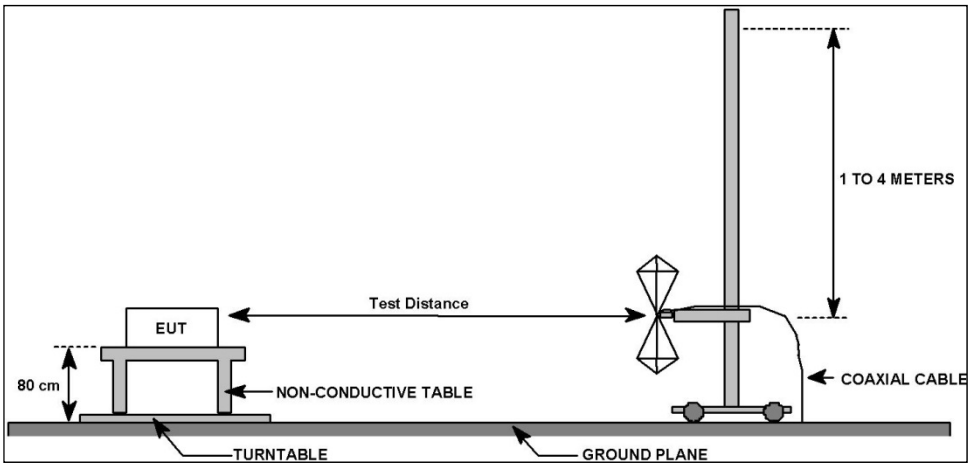


8.0 Radiated Spurious Emissions, Transmit Mode

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 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	3 Feb 2017 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.

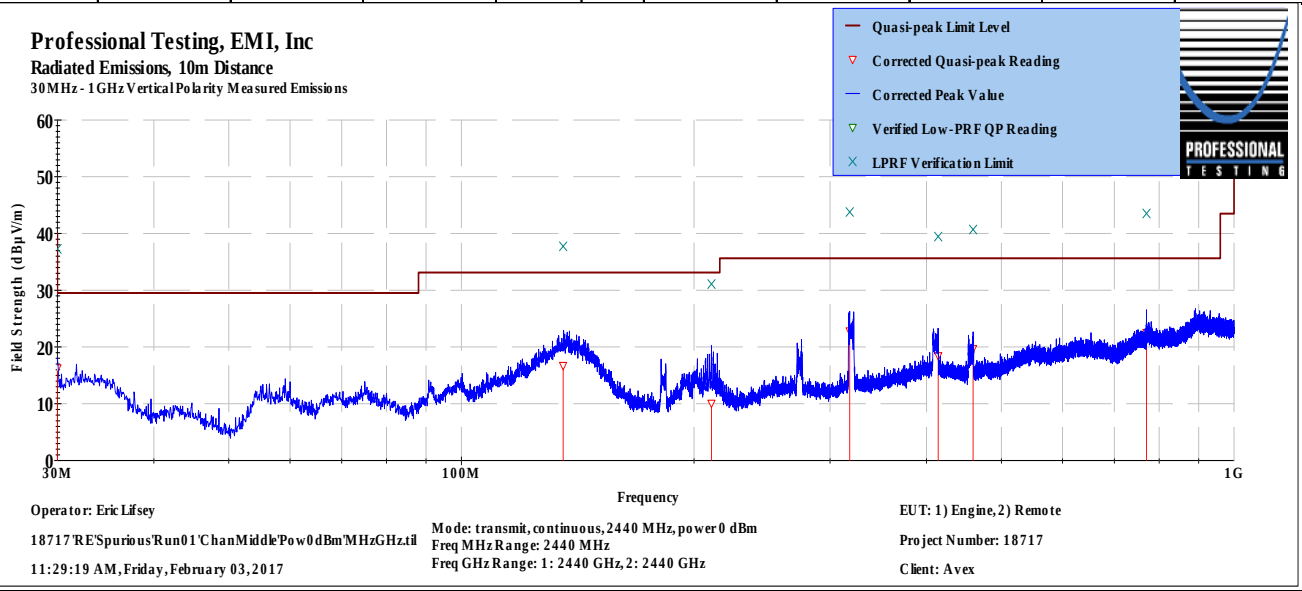
The duty cycle averaging factor applies -20.0 dB to the peaks recorded for the harmonics. As all peaks were below the peak limit, the averaged emissions are also below the average limit.

8.3.1 Middle Channel Up to 1 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	EUT Serial #:	1: 'D', 2: 'B'
Customer:	Avex	EUT Part #:	NA
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 V VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT 1 & 2: Transmit Frequency 2440 MHz		Continuous transmit unmodulated	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
30.0008	10	250	1.25	Quasi-peak	28.1	16.282	29.5	-13.2	Pass
135.439	10	7	1.65	Quasi-peak	34	16.717	33.1	-16.4	Pass
210.686	10	97	1.24	Quasi-peak	24.9	10.071	33.1	-23.0	Pass
318.111	10	10	1.25	Quasi-peak	32.6	22.79	35.6	-12.8	Pass
414.157	10	205	4.1	Quasi-peak	25.7	18.45	35.6	-17.2	Pass
459.507	10	104	3.83	Quasi-peak	27.4	19.684	35.6	-15.9	Pass
770.408	10	212	4.08	Quasi-peak	22.9	22.524	35.6	-13.1	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

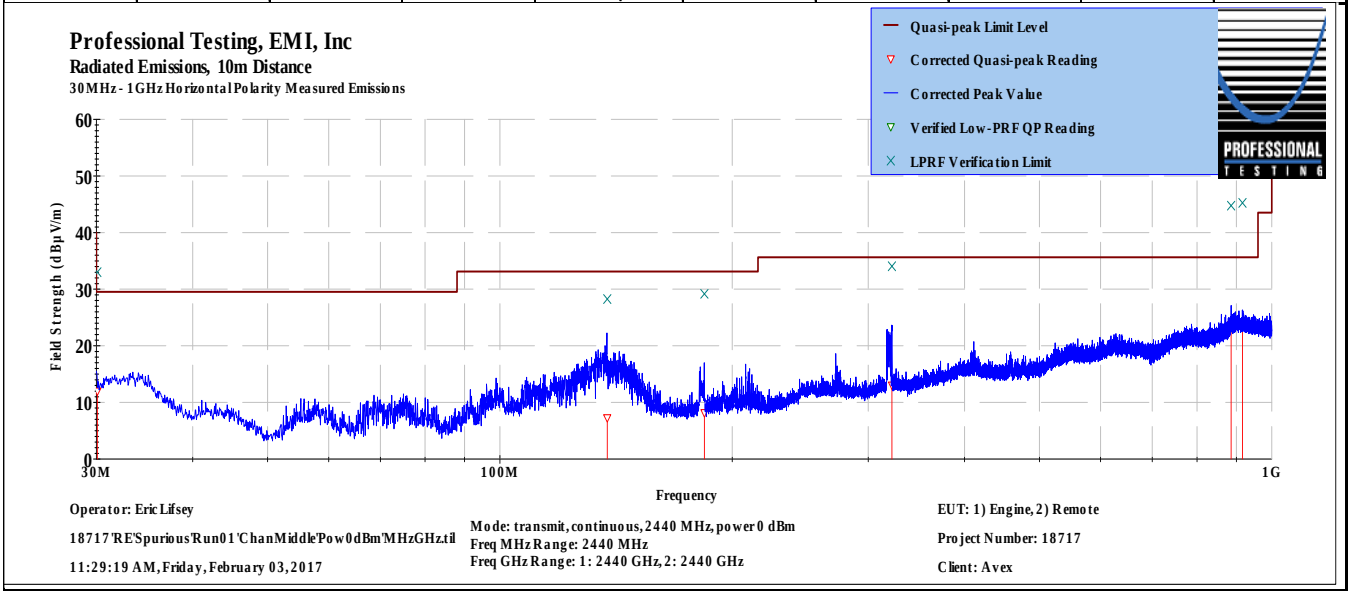
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	**EUT Serial #:**	1: 'D', 2: 'B'
Customer:	Avex	**EUT Part #:**	NA
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 V VDC	**EUT Power Frequency:**	0	N/A	
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz		
EUT 1 & 2: Transmit Frequency 2440 MHz		**Continuous transmit unmodulated**			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
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



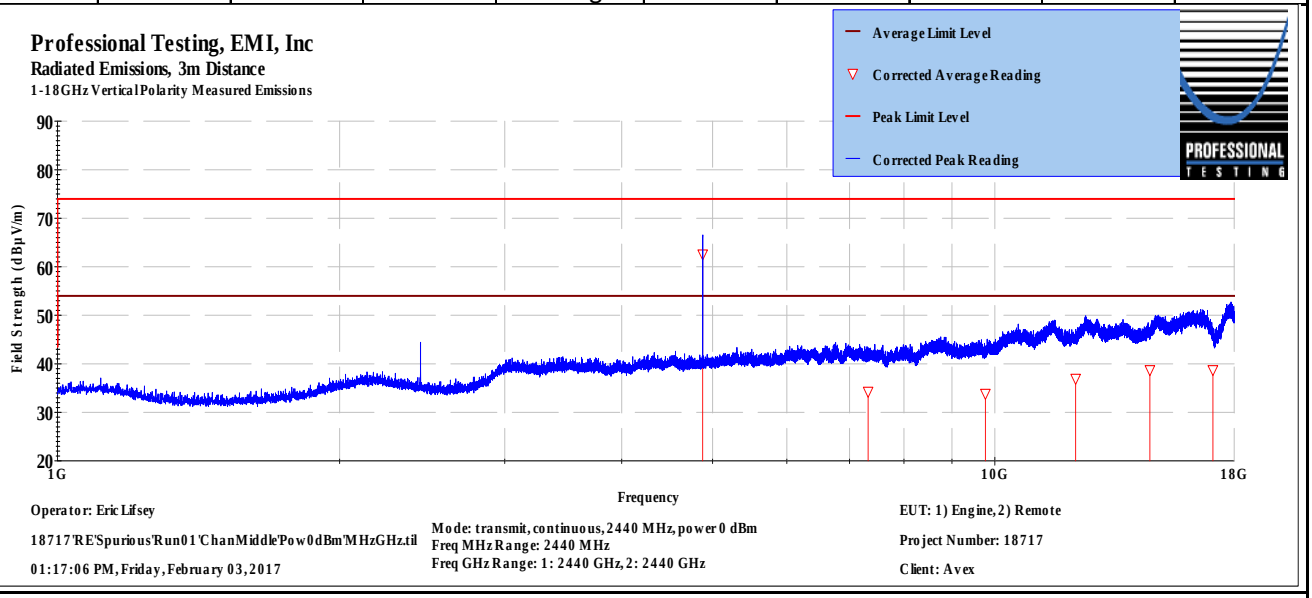
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

8.3.2 Middle Channel Up to 18 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	EUT Serial #:	1: 'D', 2: 'B'
Customer:	Avex	EUT Part #:	NA
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 V VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT 1 & 2: Transmit Frequency 2440 MHz		Continuous transmit unmodulated	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4879.99	3	106	3.16	Average	66.1	62.575	74.0	-11.4	Pass
7324.19	3	50	3.19	Average	31	34.274	54.0	-19.7	Pass
9772.86	3	294	1.17	Average	26.1	33.841	54.0	-20.1	Pass
12195.6	3	44	1.64	Average	26.5	36.935	54.0	-17.0	Pass
14638	3	27	2.91	Average	27.6	38.713	54.0	-15.2	Pass
17083.6	3	257	3.65	Average	27.1	38.743	54.0	-15.2	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

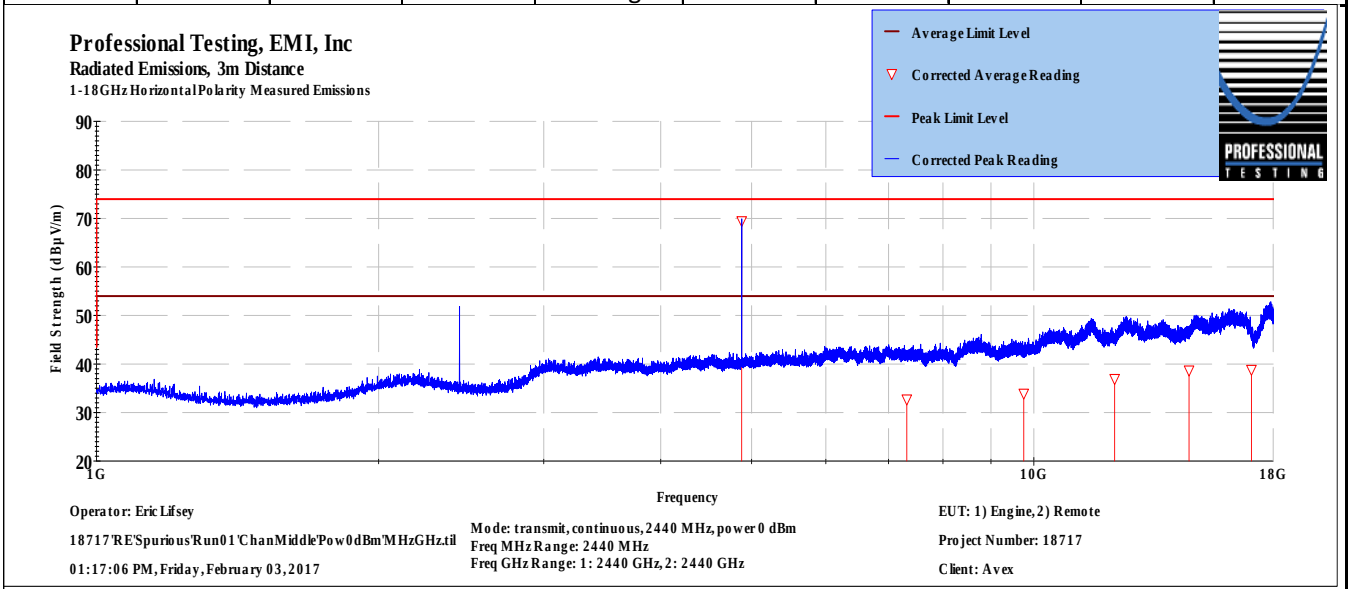
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	**EUT Serial #:**	1: 'D', 2: 'B'
Customer:	Avex	**EUT Part #:**	NA
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 V VDC	**EUT Power Frequency:**	0	N/A	
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz		
EUT 1 & 2: Transmit Frequency 2440 MHz		**Continuous transmit unmodulated**			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (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



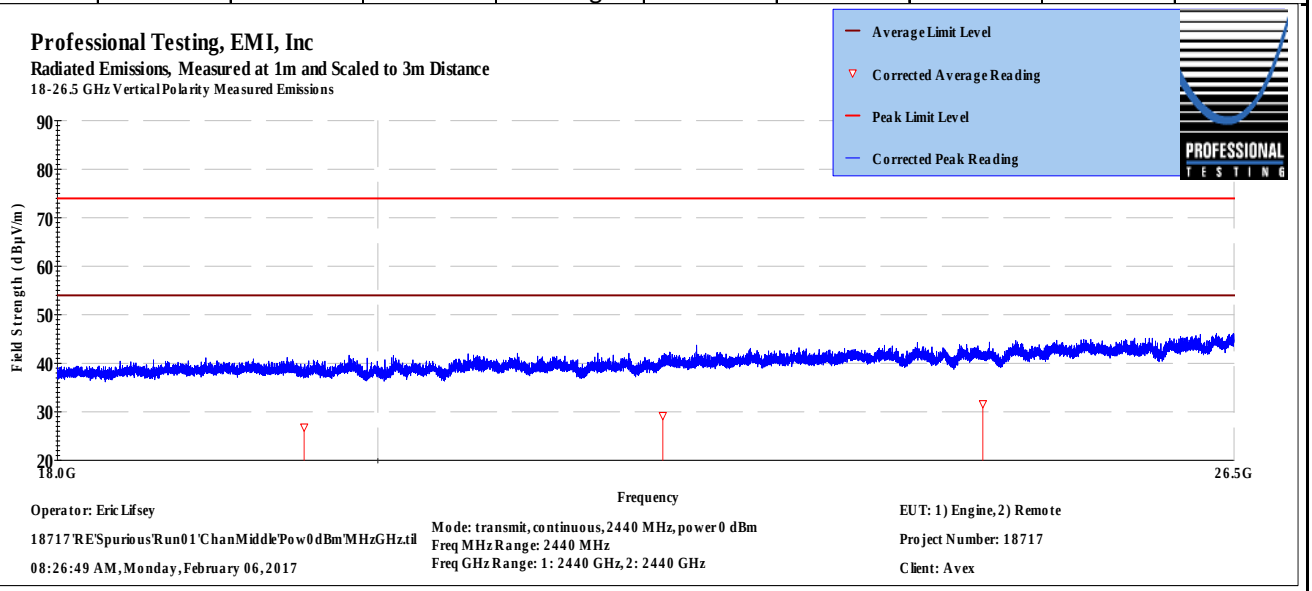
> 1GHz Horizontal Antenna Polarity Measured Emissions

8.3.3 Middle Channel Up to 25 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	EUT Serial #:	1: 'D', 2: 'B'
Customer:	Avex	EUT Part #:	NA
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 V	VDC	EUT Power Frequency:	0	N/A
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz	
EUT 1 & 2: Transmit Frequency 2440 MHz			Continuous transmit unmodulated		

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19521.3	3	333	1	Average	32.7	26.82	54.0	-27.1	Pass
21963.3	3	299	1	Average	34.7	29.217	54.0	-24.7	Pass
24400.7	3	219	1	Average	35.6	31.651	54.0	-22.3	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

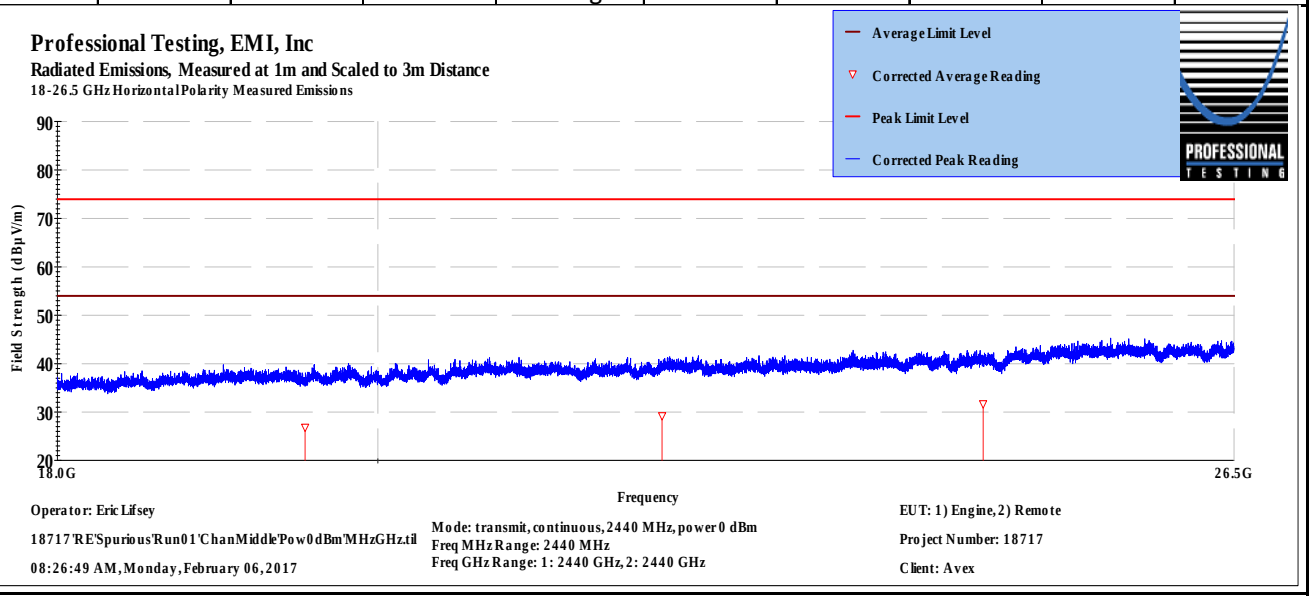
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	**EUT Serial #:**	1: 'D', 2: 'B'
Customer:	Avex	**EUT Part #:**	NA
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 V VDC	**EUT Power Frequency:**	0	N/A	
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz		
EUT 1 & 2: Transmit Frequency 2440 MHz		**Continuous transmit unmodulated**			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19526.7	3	4	1	Average	32.7	26.813	54.0	-27.1	Pass
21958.6	3	319	1	Average	34.7	29.224	54.0	-24.7	Pass
24402.8	3	151	1	Average	35.6	31.668	54.0	-22.3	Pass



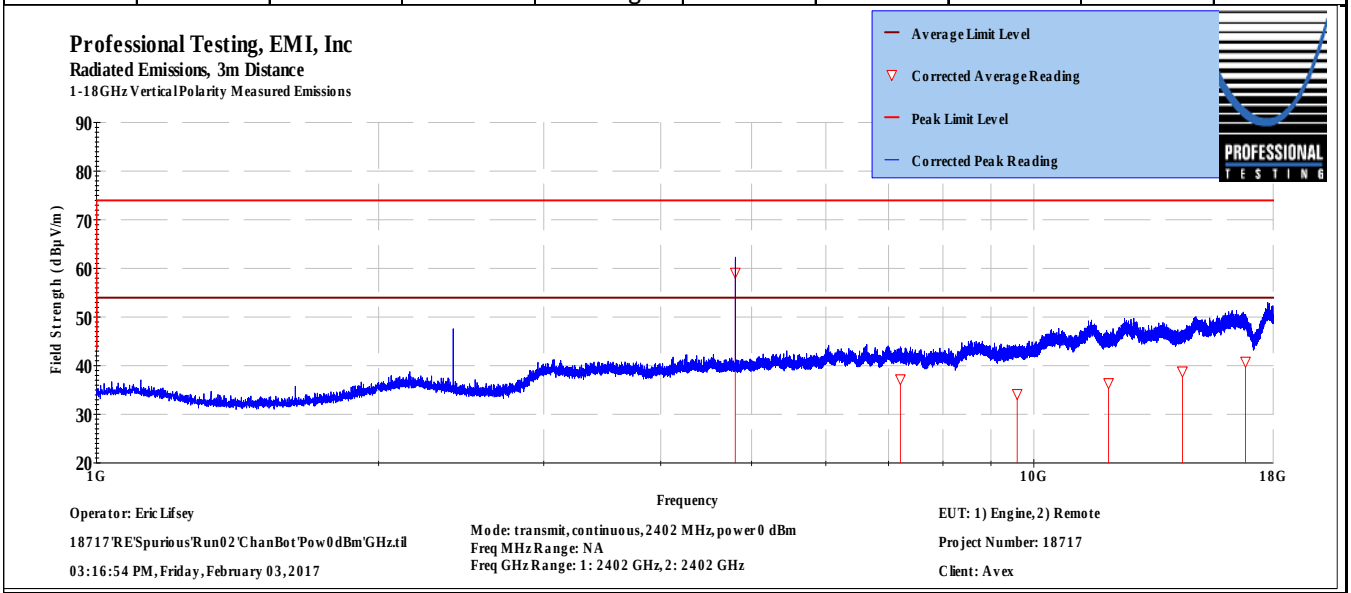
> 1GHz Horizontal Antenna Polarity Measured Emissions

8.3.4 Bottom Channel Up to 18 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	EUT Serial #:	1: 'D', 2: 'B'
Customer:	Avex	EUT Part #:	NA
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 V VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT 1 & 2: Transmit Frequency 2402 MHz		Continuous transmit unmodulated	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	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



> 1GHz Vertical Antenna Polarity Measured Emissions

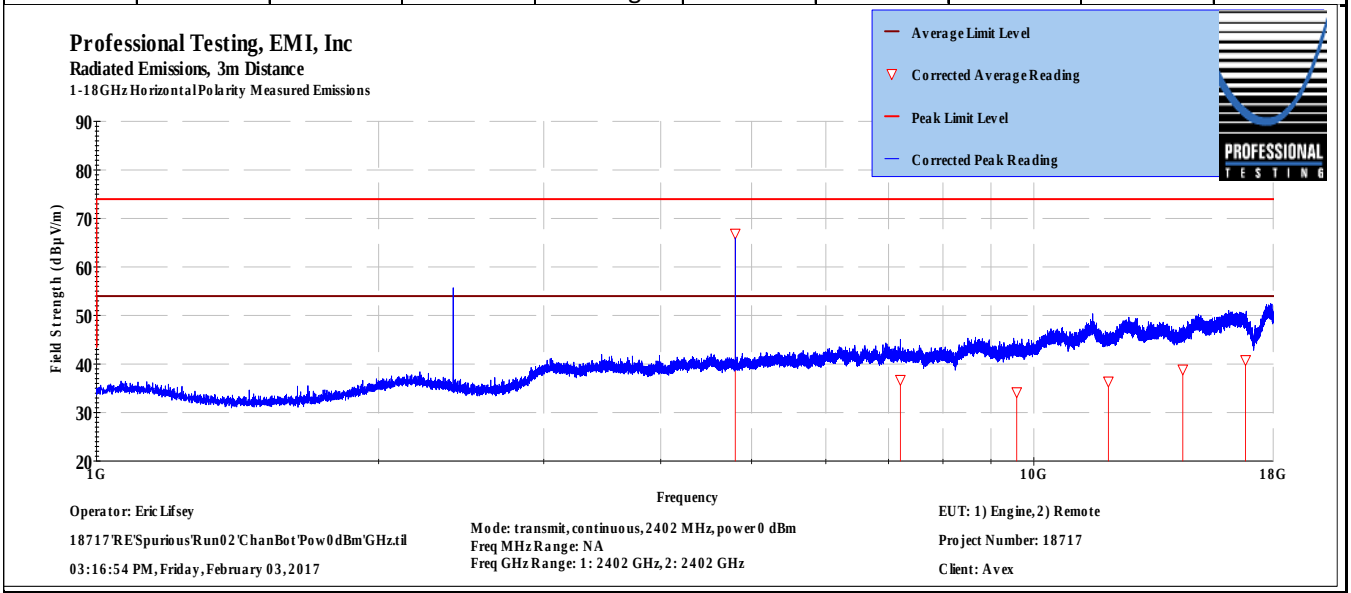
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	**EUT Serial #:**	1: 'D', 2: 'B'
Customer:	Avex	**EUT Part #:**	NA
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 V VDC	**EUT Power Frequency:**	0	N/A	
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz		
EUT 1 & 2: Transmit Frequency 2402 MHz		**Continuous transmit unmodulated**			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (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



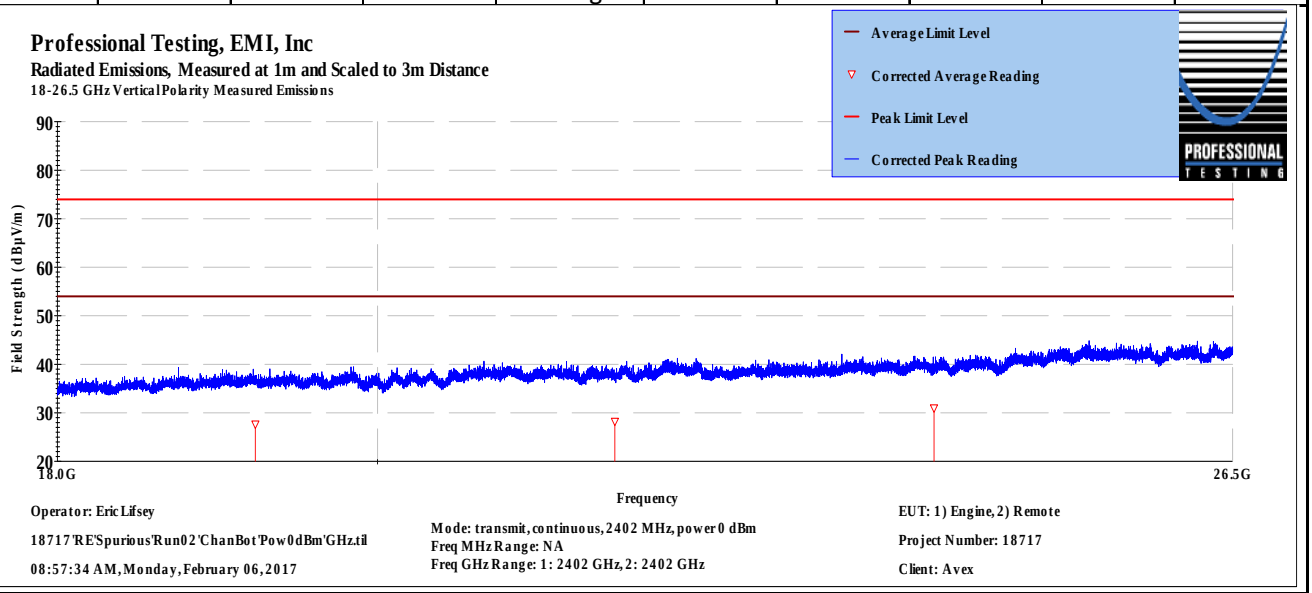
> 1GHz Horizontal Antenna Polarity Measured Emissions

8.3.5 Bottom Channel Up to 25 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	EUT Serial #:	1: 'D', 2: 'B'
Customer:	Avex	EUT Part #:	NA
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 V	VDC	EUT Power Frequency:	0	N/A
Antenna Orientation:	Vertical		Frequency Range:	Above 1GHz	
EUT 1 & 2: Transmit Frequency 2402 MHz			Continuous transmit unmodulated		

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19212.1	3	32	1	Average	33.5	27.628	54.0	-26.3	Pass
21625.6	3	129	1	Average	34.1	28.229	54.0	-25.7	Pass
24019.4	3	149	1	Average	35.1	30.955	54.0	-23.0	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

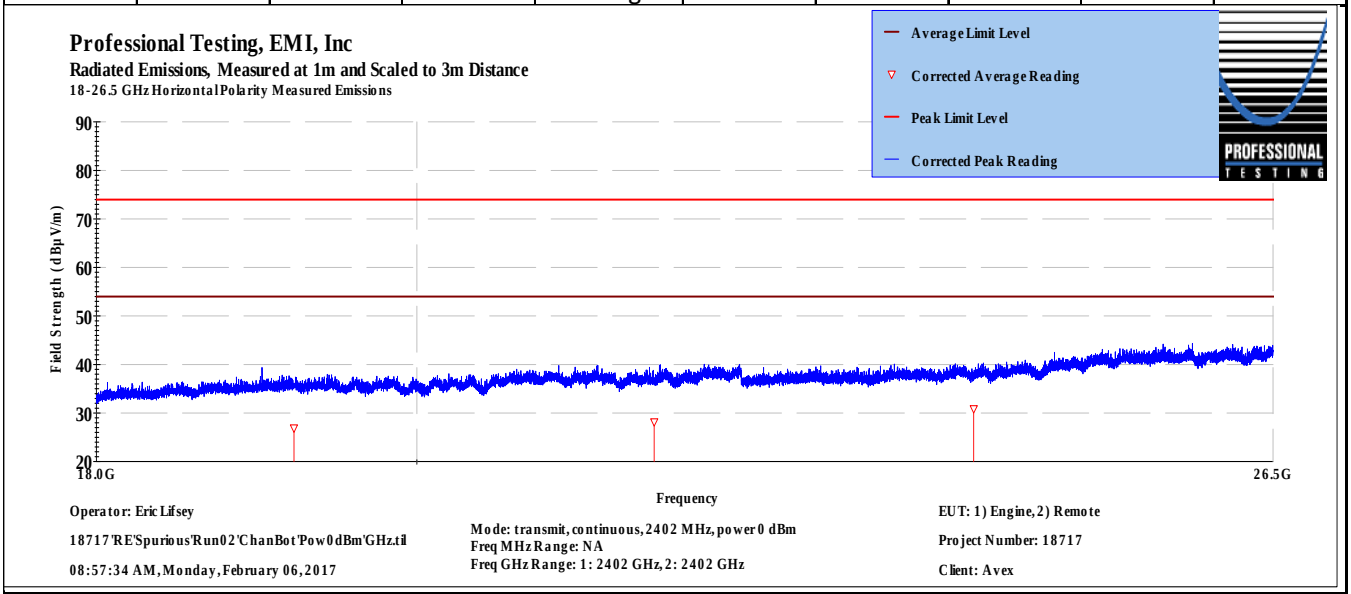
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	**EUT Serial #:**	1: 'D', 2: 'B'
Customer:	Avex	**EUT Part #:**	NA
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 V VDC	**EUT Power Frequency:**	0	N/A	
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz		
EUT 1 & 2: Transmit Frequency 2402 MHz		**Continuous transmit unmodulated**			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19207.8	3	153	1	Average	32.8	26.864	54.0	-27.1	Pass
21622.3	3	292	1	Average	34	28.144	54.0	-25.8	Pass
24017.1	3	183	1	Average	35	30.829	54.0	-23.1	Pass



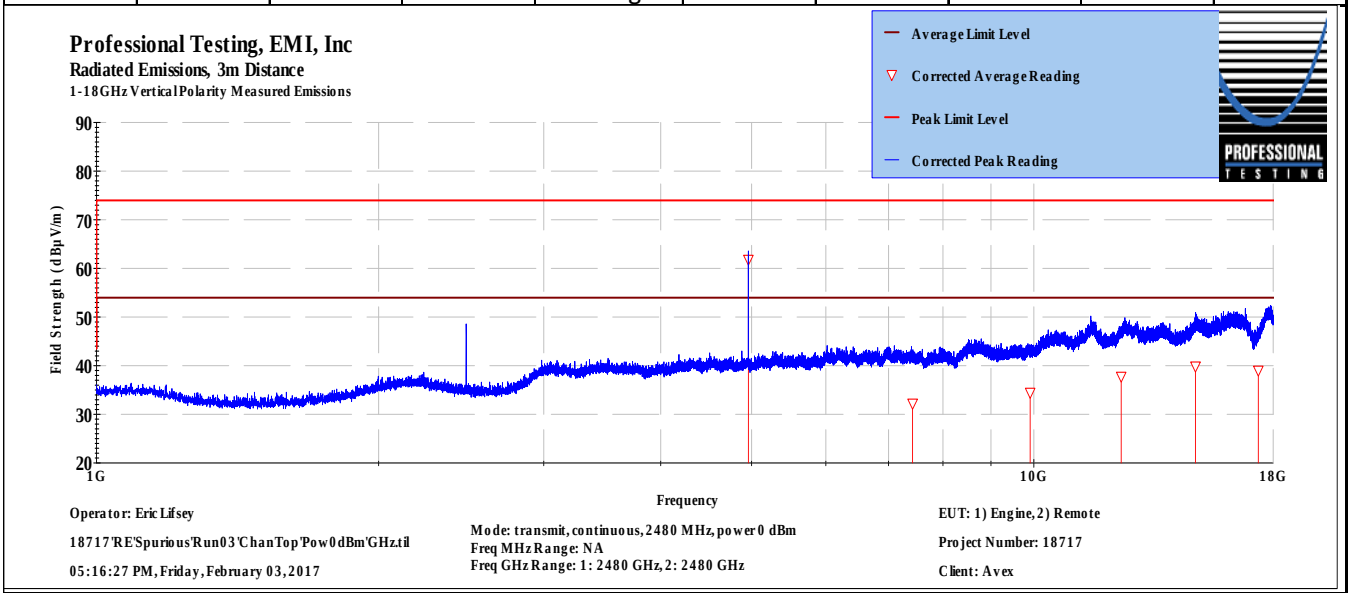
> 1GHz Horizontal Antenna Polarity Measured Emissions

8.3.6 Top Channel Up to 18 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	EUT Serial #:	1: 'D', 2: 'B'
Customer:	Avex	EUT Part #:	NA
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 V VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT 1 & 2: Transmit Frequency 2480 MHz		Continuous transmit unmodulated	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (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



> 1GHz Vertical Antenna Polarity Measured Emissions

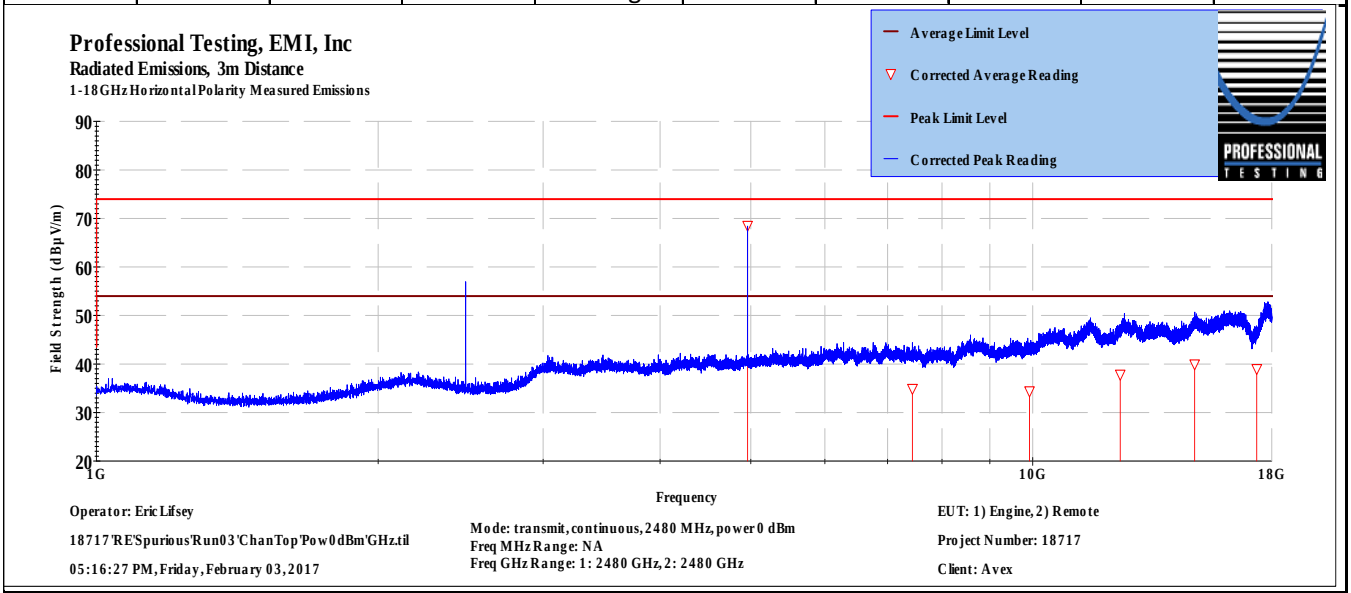
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	**EUT Serial #:**	1: 'D', 2: 'B'
Customer:	Avex	**EUT Part #:**	NA
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 V VDC	**EUT Power Frequency:**	0	N/A	
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz		
EUT 1 & 2: Transmit Frequency 2480 MHz		**Continuous transmit unmodulated**			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
4959.99	3	56	2.87	Average	71.7	68.514	74.0	-5.5	Pass
7439.99	3	80	2.23	Average	31.2	34.896	54.0	-19.1	Pass
9921.93	3	234	1.35	Average	26.5	34.4	54.0	-19.6	Pass
12401.5	3	336	1.57	Average	27.1	37.822	54.0	-16.1	Pass
14890.1	3	228	1.29	Average	28.3	39.955	54.0	-14.0	Pass
17348.7	3	352	3.05	Average	26.6	38.991	54.0	-15.0	Pass



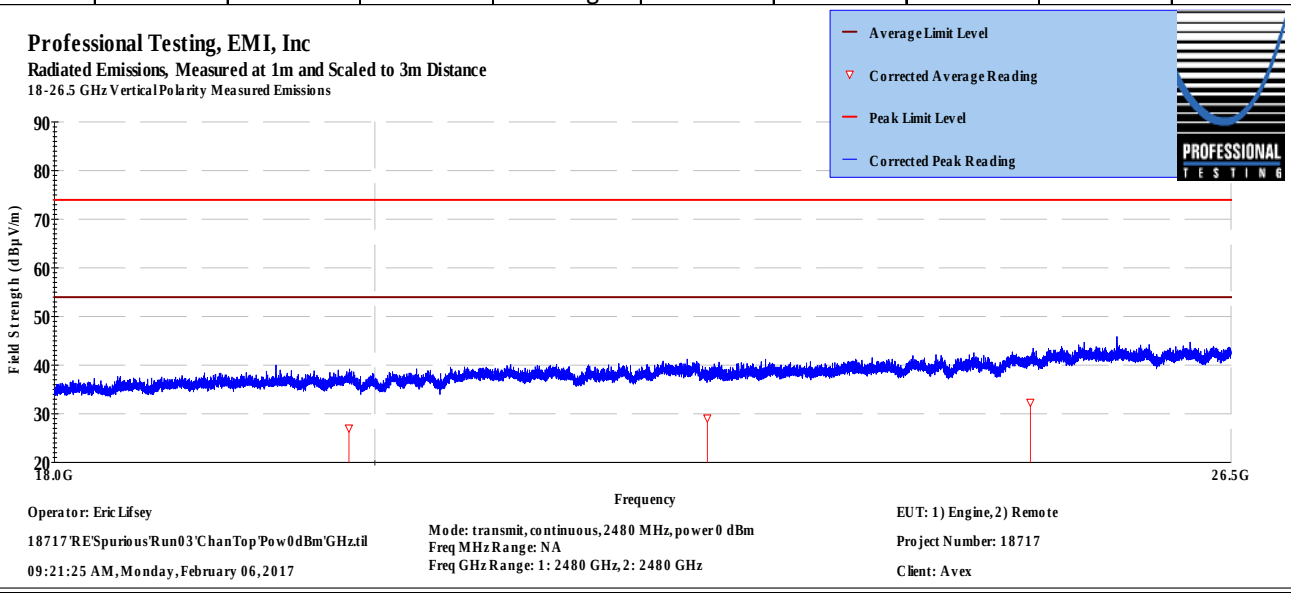
> 1GHz Horizontal Antenna Polarity Measured Emissions

8.3.7 Top Channel Up to 25 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	EUT Serial #:	1: 'D', 2: 'B'
Customer:	Avex	EUT Part #:	NA
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 V VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT 1 & 2: Transmit Frequency 2480 MHz		Continuous transmit unmodulated	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19830	3	47	1	Average	32.8	27.059	54.0	-26.9	Pass
22309.3	3	95	1	Average	34.3	29.125	54.0	-24.8	Pass
24809.3	3	95	1	Average	36.1	32.352	54.0	-21.6	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

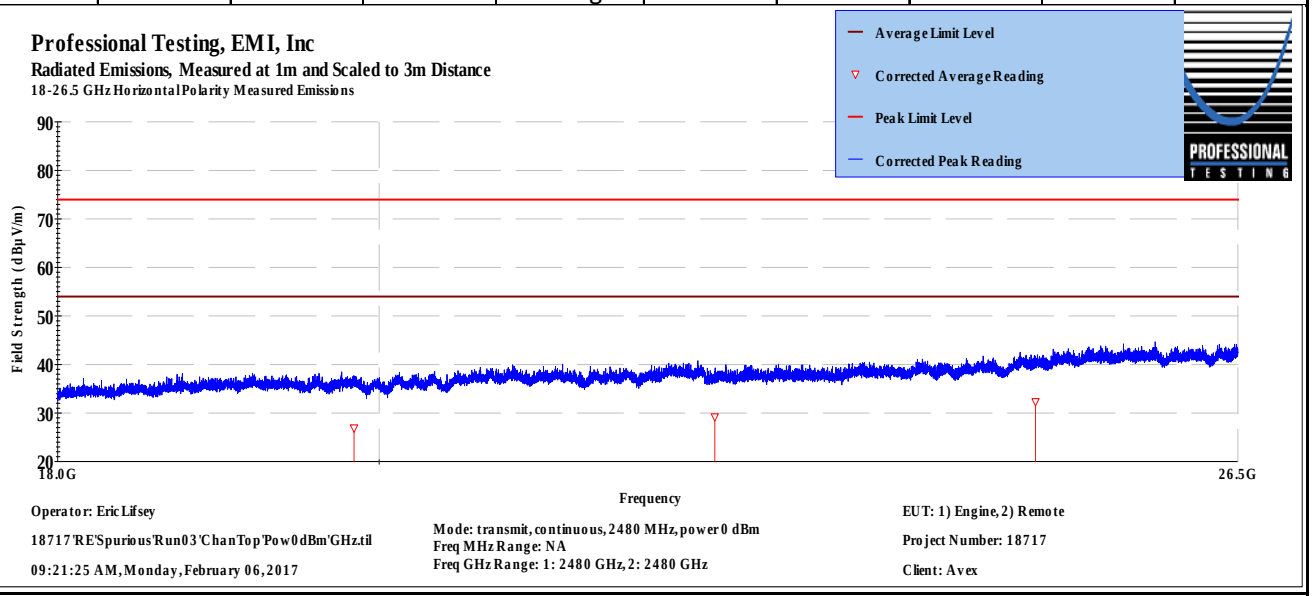
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/3/2017, 2/6/2017	**EUT Serial #:**	1: 'D', 2: 'B'
Customer:	Avex	**EUT Part #:**	NA
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 V VDC	**EUT Power Frequency:**	0	N/A	
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz		
EUT 1 & 2: Transmit Frequency 2480 MHz		**Continuous transmit unmodulated**			

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
19835.8	3	157	1	Average	32.6	26.883	54.0	-27.1	Pass
22324.9	3	104	1	Average	34.3	29.163	54.0	-24.8	Pass
24799.9	3	108	1	Average	36.1	32.325	54.0	-21.6	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

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 // RSS-Gen 8.3	Mains Conducted Emission	3 Mar 2017

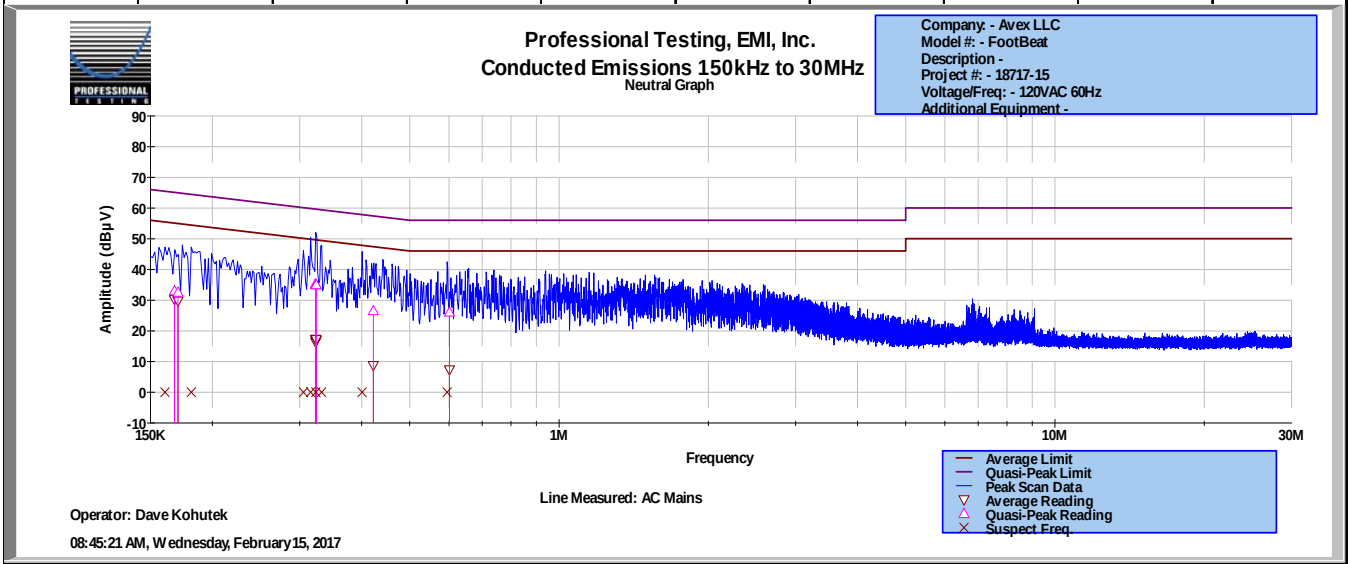
9.3 Results

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 **Page: 1 of 2**

EUT Line Voltage:			**120**	**VAC**	**EUT Line Frequency:**			**60**	**Hz**
Frequency Measured (MHz)	**Peak Detector Reading (dBµV)**	**Quasi-peak Detector Reading (dBµV)**	**Quasi-peak Detector Limit (dBµV)**	**Quasi-peak Detector Margin (dB)**	**Quasi-peak Detector Test Results**	**Average Detector Reading (dBµV)**	**Average Detector Limit (dBµV)**	**Average Detector Margin (dB)**	**Average Detector Test 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



Measured Conducted Emissions - Neutral Lead

Professional Testing, EMI, Inc.

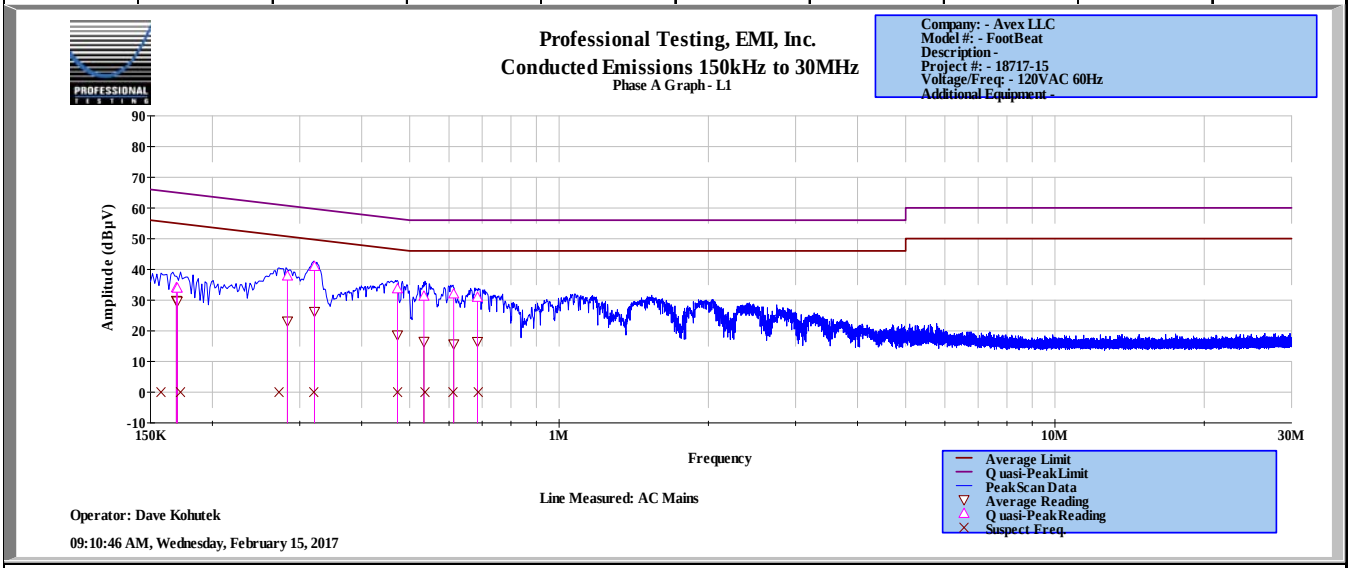
Test Method:	**ANSI C63.4–2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (incorporated by reference, see §15.38).**
In accordance with:	**FCC Part 15.107 - Code of Federal Regulations Part 47, Subpart B - Unintentional 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) **Page: 2 of 2**

EUT Line Voltage:	**120**	**VAC**	**EUT Line Frequency:**	**60**	**Hz**

Frequency Measured (MHz)	Peak Detector Reading (dBµV)	Quasi-peak Detector Reading (dBµV)	Quasi-peak Detector Limit (dBµV)	Quasi-peak Detector Margin (dB)	Quasi-peak Detector Test Results	Average Detector Reading (dBµV)	Average Detector Limit (dBµV)	Average Detector Margin (dB)	Average Detector Test 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



Measured Conducted Emissions - Phase Lead (Line 1)

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 // 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

Radiated Emissions Test Equipment List					
Tile! Software Version:		**4.2.A, May 23, 2010, 08:38:52 AM**			
Test Profile:		**2016 RE_ClassA - Boresite+Mast_LowPRF_120516.til or 2016 RE_Class**B **- Boresite+Mast_LowPRF_120516.til**			
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration 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, 28/25dB	3313A05298	2/1/2018
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, 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
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	6/19/2017
2004	Miteq	AFS44-00101800-2S-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 Horn, 1 - 18 GHz	110313	2/25/2017
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/15/2017
1542	A.H. Systems	SAS-572	Antenna, Horn 18-26.5GHz, 20dB gain	225	11/20/2018
1973	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500497	11/17/2018

11.2 Bandwidth

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	30 Sep 2017

11.1 Duty Cycle

Asset #	Manufacturer	Model #	Description	Calibration 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					
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 Due Date**
1145	HP	8568B	Spectrum Analyzer 100Hz-1.5GHz	2517A01821	7/20/2017
1834	HP	85662A	Spec Anal Dsply, use with A/N 1145	2349A06182	N/A
0990	HP	85685A	RF Preselector	3010A01119	7/20/2017
0085	HP	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	HP	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 (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of 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 (MHz)	**Frequency Band Stop (MHz)**	**6 dB Bandwidth (kHz)**	**Number of Ranges Used**	**Measurement Time per 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 Uncertainty 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

End of Report

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