Project 20024-15

Shelfbucks, Inc.
MB-4-C

Wireless Certification Report

Prepared for:

Shelfbucks, Inc.
2500 Bee Caves Rd Bldg.2, Suite 240
Austin, TX 78746

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

14 May 2018

Reviewed by

Larry Finn
Chief Technical Officer

Written by

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
Draft 01	Draft for review.	14 May 2018
Final 01		2 Jul 2018

Errata:

None.

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Compliance Certificate

Applicant	Device & Test Identification	
Shelfbucks, Inc. 2500 Bee Caves Rd Bldg.2, Suite 240 Austin, TX 78746 Certificate Date: 14 May 2018	FCC ID: Industry Canada ID: Model(s): Laboratory Project ID:	2ALSL-MB-4-C N/A MB-4-C 20024-15

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 2	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 5	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
Shelfbucks, Inc. Model: MB-4-C	none	902-928 MHz radio using 1 channel in a proprietary scheme

Table 1.2.2: Support Equipment

Manufacturer / Model	Serial #	Description
N/A	none	

The EUT is a small battery powered device that attaches to signage. It sends widely-spaced status information via a proprietary wireless network. It is battery powered by coin type cells.

The EUT electronics are on a single circuit board which measures approximately 4.2 cm x 2.2 cm x 0.5 cm. The EUT is placed inside a small bag and the bag is affixed to the signage.

1.3 EUT Operation

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

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 2	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.

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 (30 dBm) Limit Restated as Field: 125.23 dBµV/m @ 3 m	14 May 2018

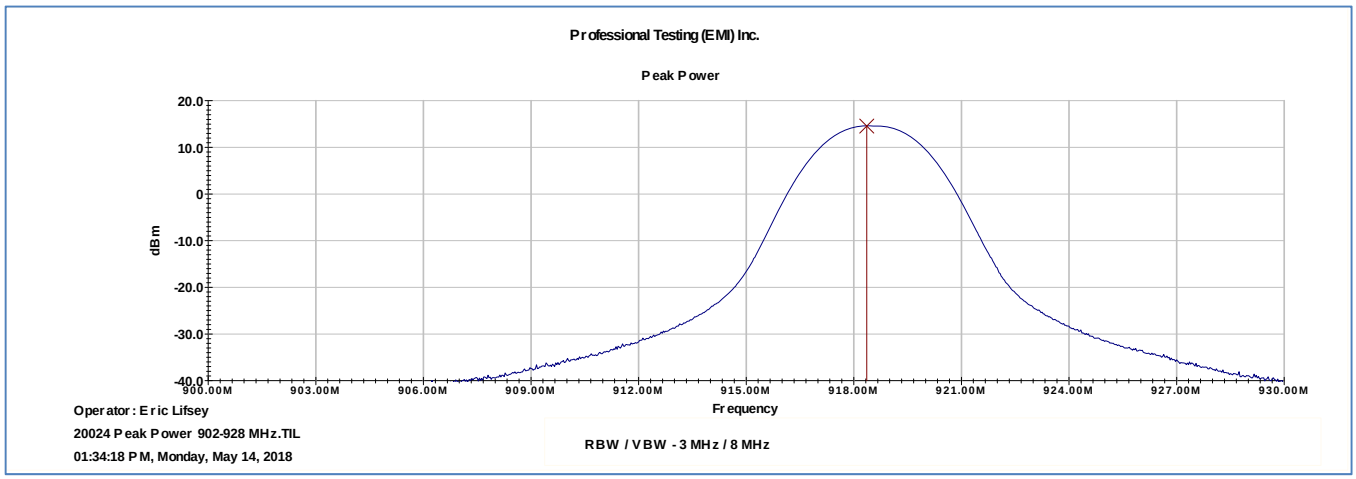
2.3 Test Results, Peak Power

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**
918.36	14.6	28.8

Measured in 3 MHz RBW, 8 MHz VBW.

The EUT 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.

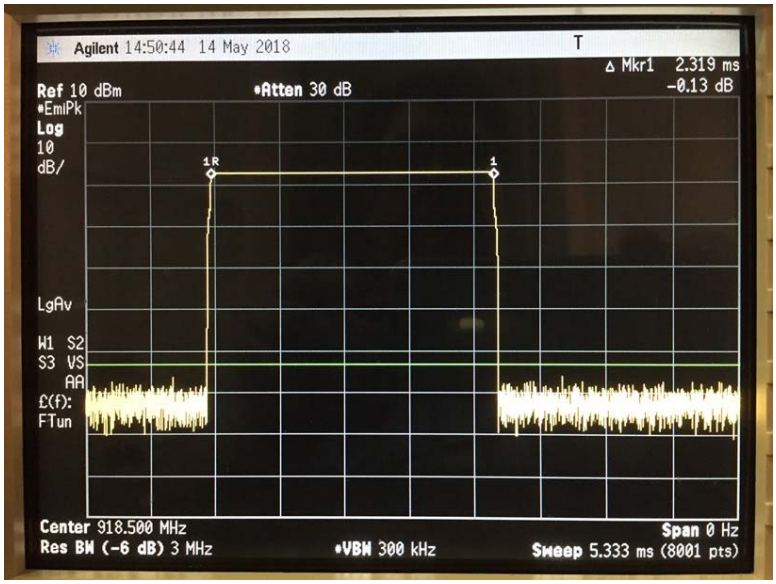
Table 2.4.1 Duty Cycle Results and Average Duty Cycle Factor Result

Total Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
= 2.32	1218 Allowed 100 ms	= 20 * Log_{10} (2.32 msec / 100 msec)	-32.7	-20

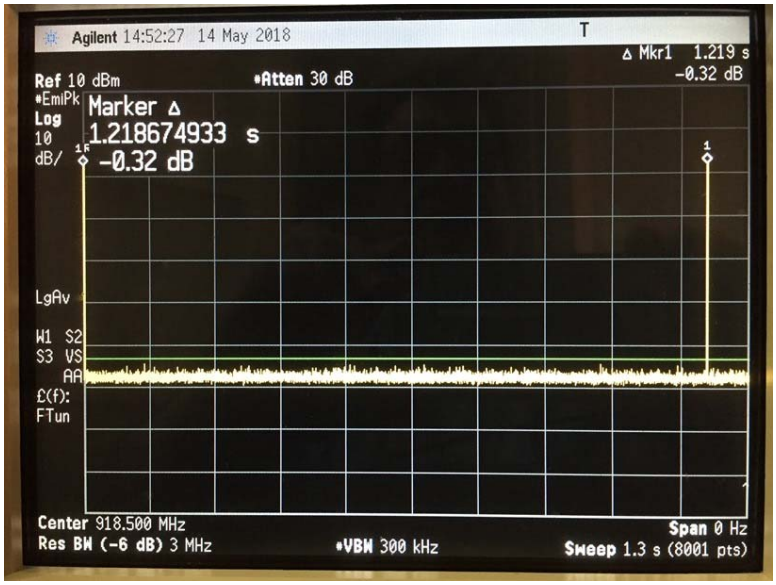
Factor for averaging exposure: -32.7 / 2 = 16.35 dB

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

Plotted results appear below.



Transmit Event



Transmit Interval

3.0 Power Spectral Density

3.1 Test Procedure

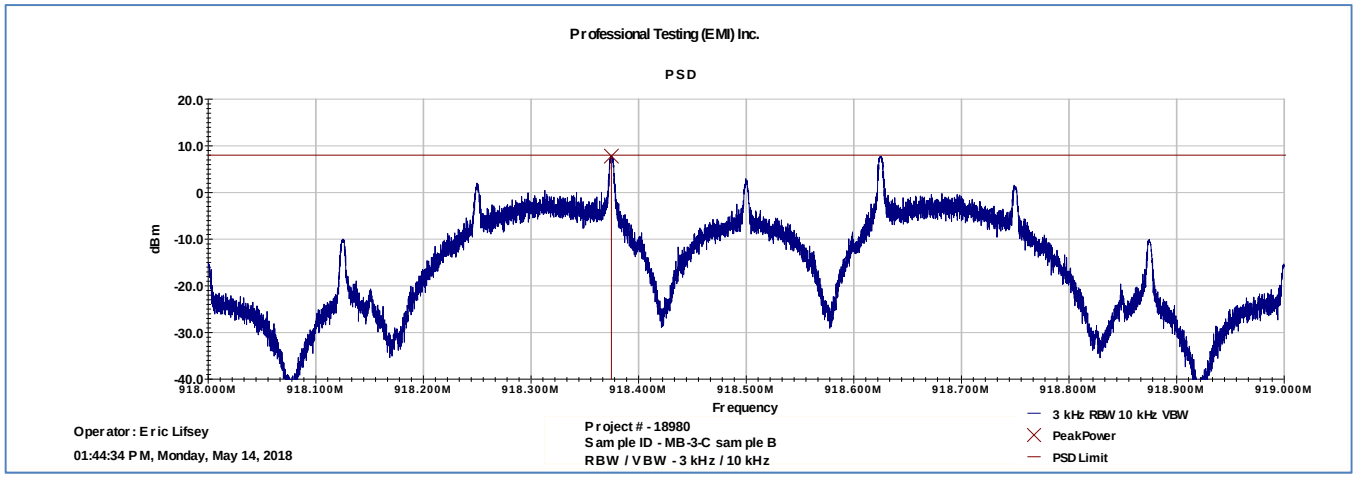
A spectrum analyzer is either connected directly to the EUT or used by radiated means to measure the fundamental emission. It is adjusted to measure the power spectral density in the specified resolution bandwidth.

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	14 May 2018

3.3 Test Results

The EUT satisfied the requirements.



Peak Power 7.8 dBm in 3 kHz RBW

4.0 Occupied Bandwidth

4.1 Test Procedure

Bandwidth is measured by conducted 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, 99%	14 May 2018

4.3 Test Results

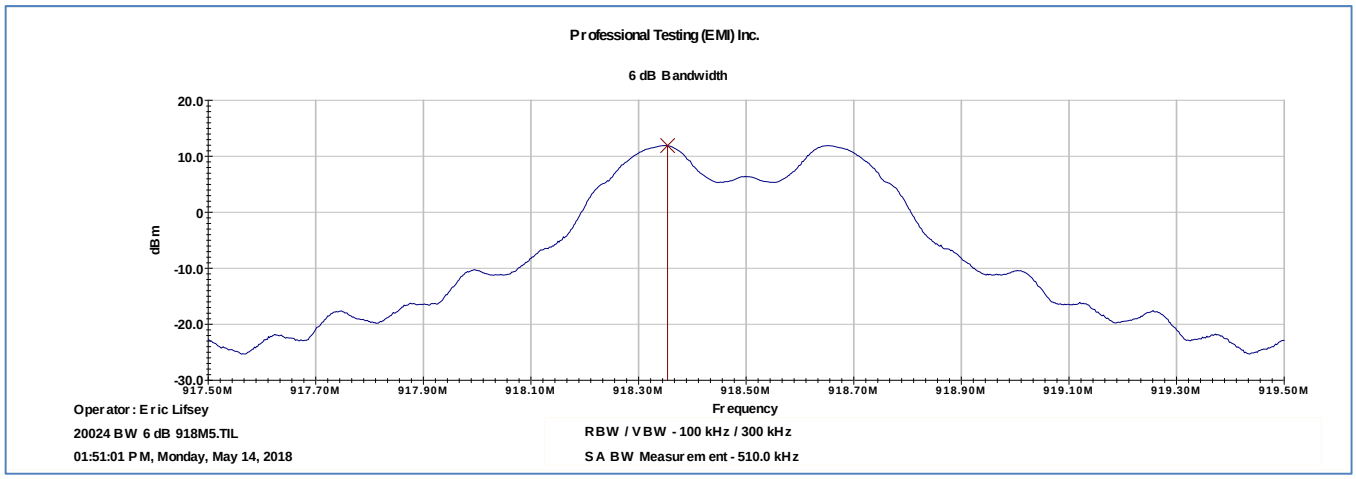
The bandwidth measurement is used to verify DTS characteristics and/or for general reporting for agency application.

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

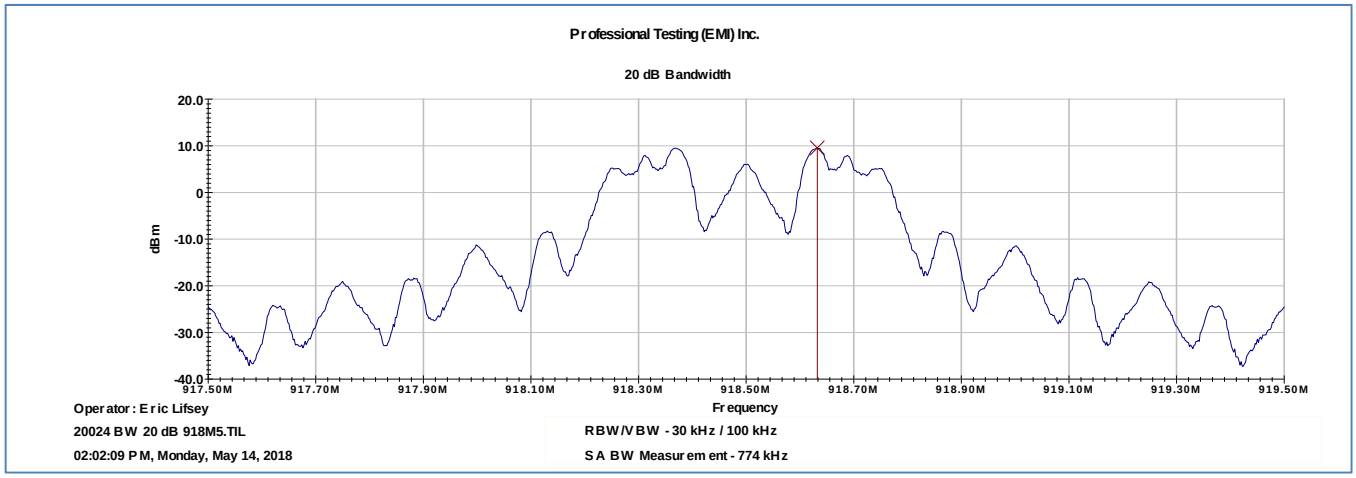
Table 4.3.1 Bandwidth			
Bandwidth 6 dB, Minimum 500 kHz in 100 kHz RBW			
	Channel Measured BW (kHz)		**Reported Minimum BW (kHz)**
	510		**510**
Bandwidth 20 dB, Measure and Report			
	Channel Measured BW (kHz)		**Reported Maximum BW (kHz)**
	774		**774**
Bandwidth 99%, Measure and Report			
	Channel Measured BW (kHz)		**Reported Maximum BW (kHz)**
	743		**743**

Plotted measurements appear on the following pages.

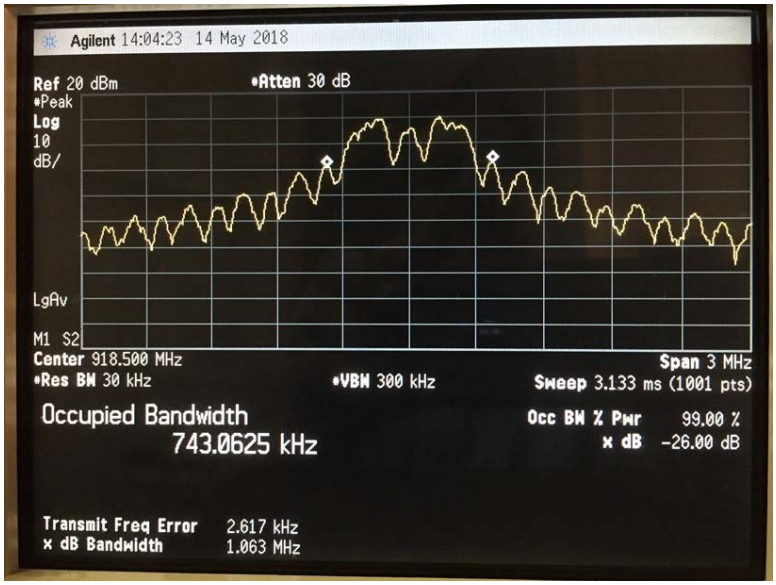
4.3.1 Bandwidth Plots, 6 dB



4.3.2 Bandwidth Plots, 20 dB



4.3.3 Bandwidth Plots, 99%



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

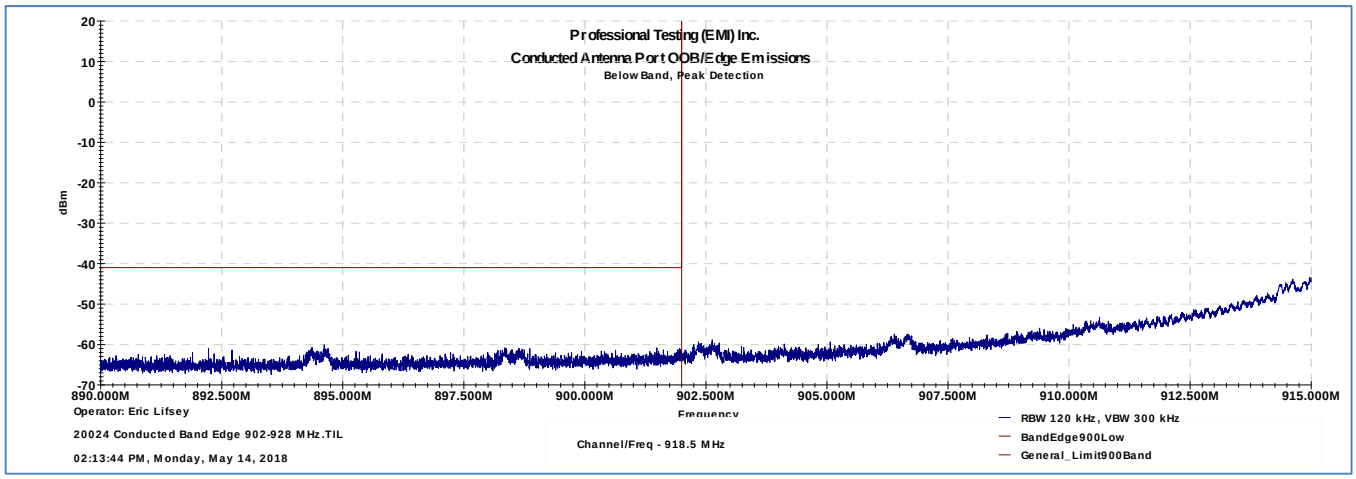
47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.205 // RSS-247 5.5, RSS-Gen 4.9	Unwanted Emissions Adjacent to Authorized Band, Radiated	14 May 2018

5.3 Test Results

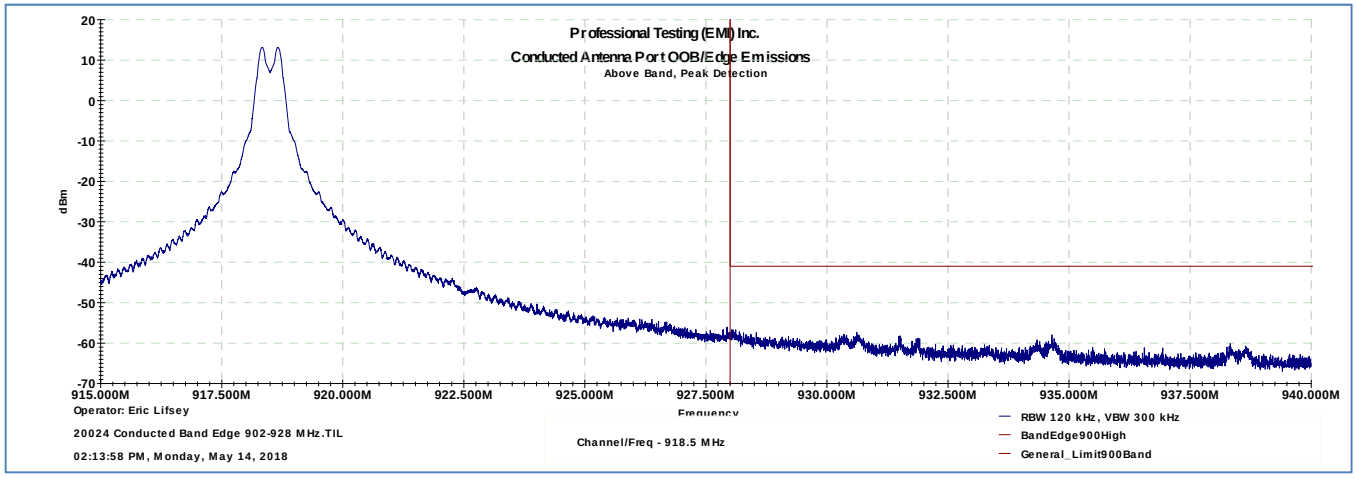
Measurements included more than 2 standard bandwidths (standard bandwidth 120 kHz) from the band edges to provide a clear view of the fundamental and the declining emission levels. Peak detection with max-hold was employed for a conducted measurement.

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

5.3.1 Low Channel Band Edge



5.3.2 High Channel Band Edge

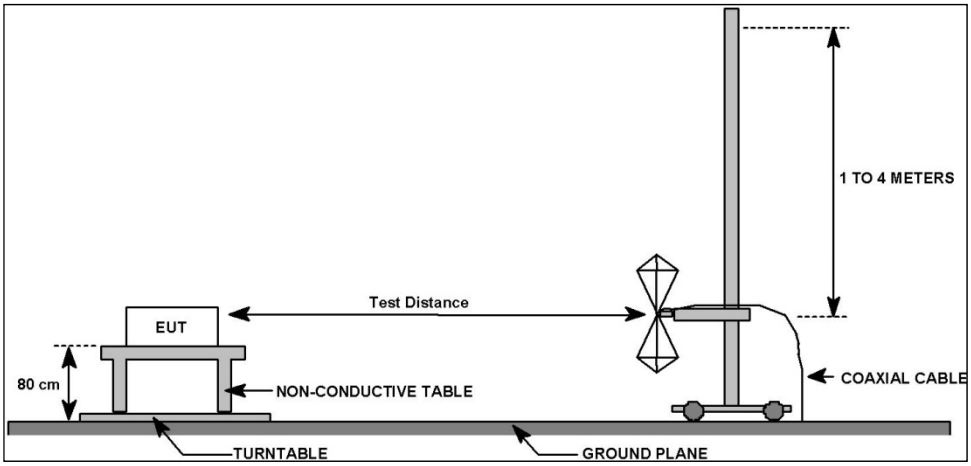


6.0 Radiated Spurious Emissions, Receive Mode

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	14 May 2018

6.3 Test Results

The EUT was tuned to the middle channel and placed in receive mode.

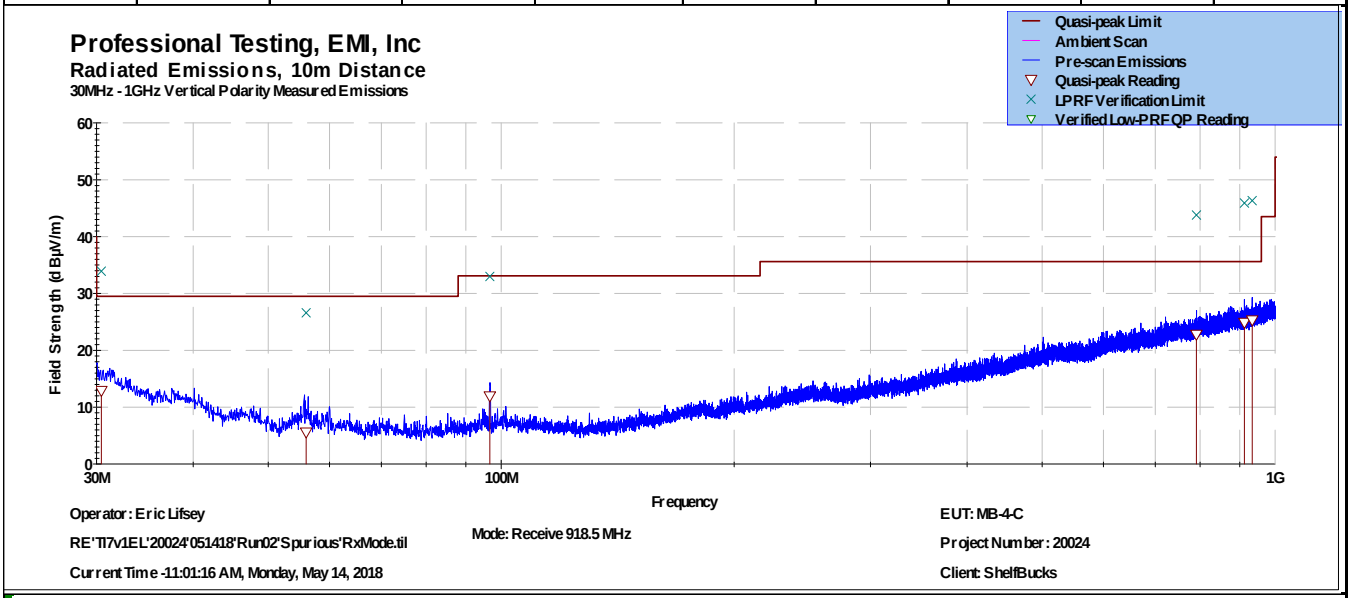
The EUT satisfied the criteria. Recorded data is presented below.

6.3.1 Up to 1 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
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):	5/14/2018	EUT Serial #:	0
Customer:	ShelfBucks	EUT Part #:	MB-4-C
Project Number:	20024	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	MB-4-C	Witness' Name:	Devin Murphy

Radiated Emissions Test Results Data Sheet		Page: 1 of 1	
EUT Line Voltage:	3 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Receive 918.5 MHz	

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
30.433	10	102	2.96	Quasi-peak	24.12	12.906	29.5	-16.6	Pass
55.97	10	160	3.55	Quasi-peak	25.014	5.585	29.5	-23.9	Pass
96.664	10	147	1.28	Quasi-peak	30.361	11.962	33.1	-21.1	Pass
791.371	10	227	1.54	Quasi-peak	21.38	22.776	35.6	-12.8	Pass
912.934	10	208	3.03	Quasi-peak	21.081	24.888	35.6	-10.7	Pass
933.971	10	339	3.8	Quasi-peak	21.058	25.308	35.6	-10.3	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

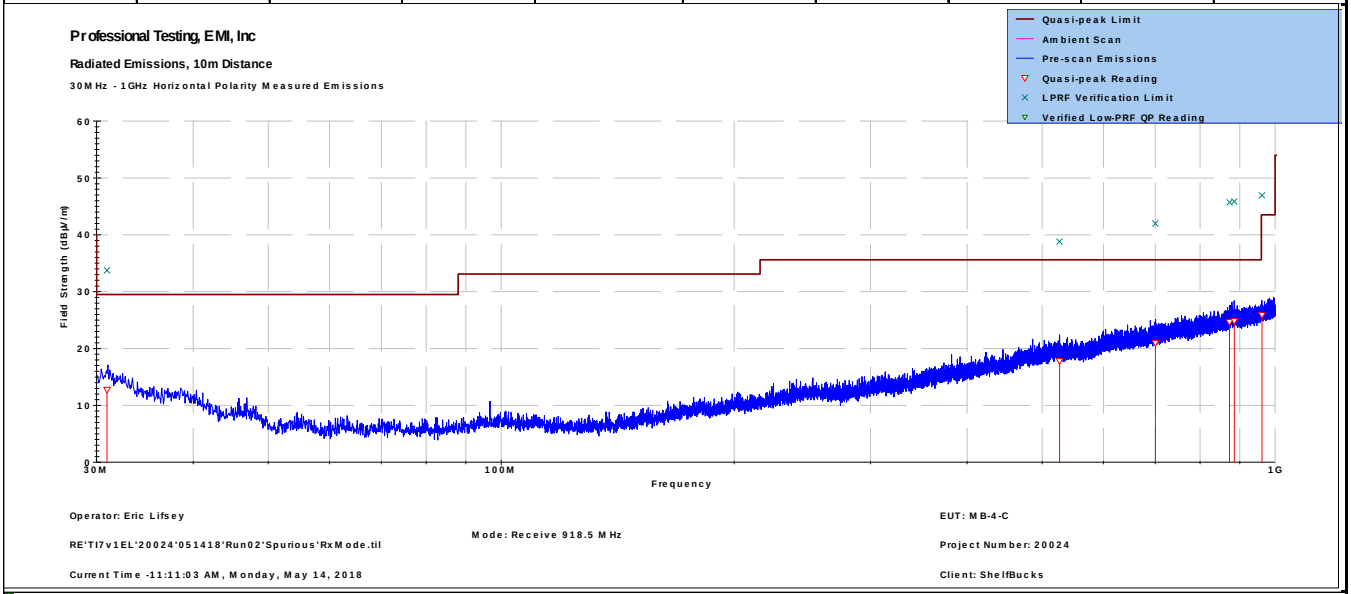
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
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):	5/14/2018	**EUT Serial #:**	0
Customer:	ShelfBucks	**EUT Part #:**	MB-4-C
Project Number:	20024	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MB-4-C	**Witness' Name:**	Devin Murphy

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Receive 918.5 MHz	

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
30.948	10	88	3.37	Quasi-peak	24.16	12.728	29.5	-16.8	Pass
526.537	10	8	1.49	Quasi-peak	22.201	17.798	35.6	-17.8	Pass
700.443	10	175	1.83	Quasi-peak	21.826	20.98	35.6	-14.6	Pass
873.106	10	223	2.89	Quasi-peak	21.33	24.684	35.6	-10.9	Pass
885.573	10	176	3.92	Quasi-peak	21.328	24.838	35.6	-10.8	Pass
961.762	10	149	1.13	Quasi-peak	20.966	25.916	43.5	-17.6	Pass



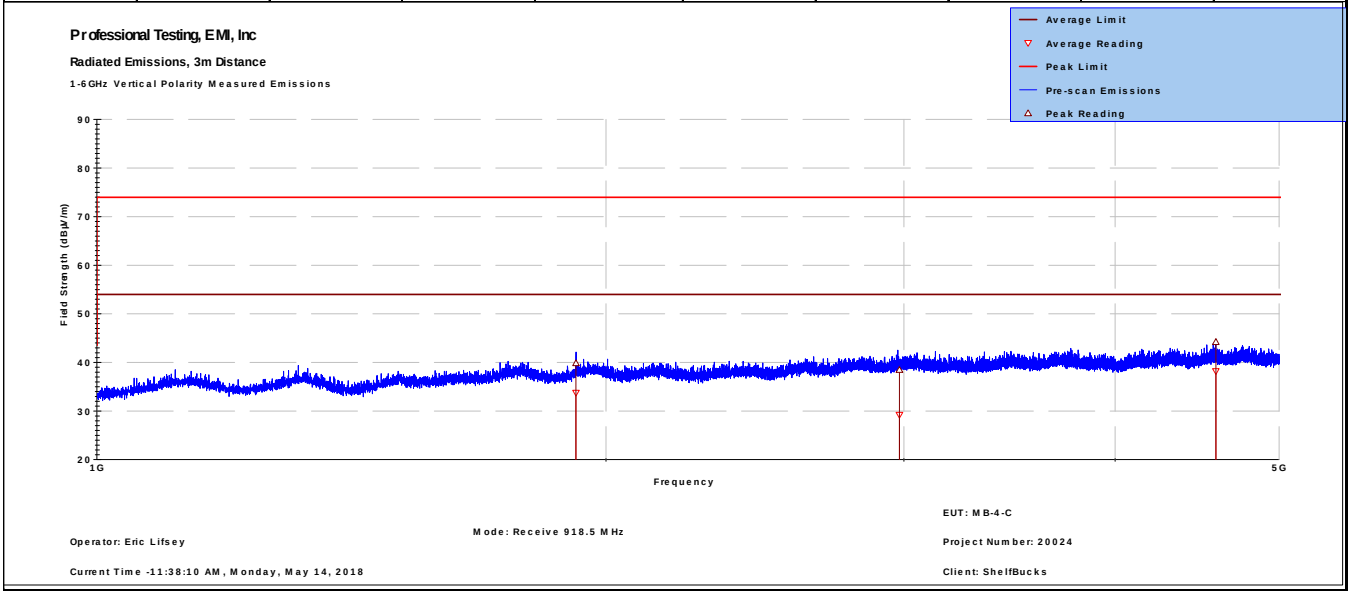
≤ 1GHz Horizontal Antenna Polarity Measured Emissions

6.3.2 Up to 5 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
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):	5/14/2018	EUT Serial #:	0
Customer:	ShelfBucks	EUT Part #:	MB-4-C
Project Number:	20024	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	MB-4-C	Witness' Name:	Devin Murphy

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Receive 918.5 MHz	

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
1919.96	3	277	2.27	Average	43.1	33.774	54.0	-20.2	Pass
2982.15	3	218	1.94	Average	36.2	29.235	54.0	-24.7	Pass
4587.52	3	170	1.47	Average	42.5	38.199	54.0	-15.8	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

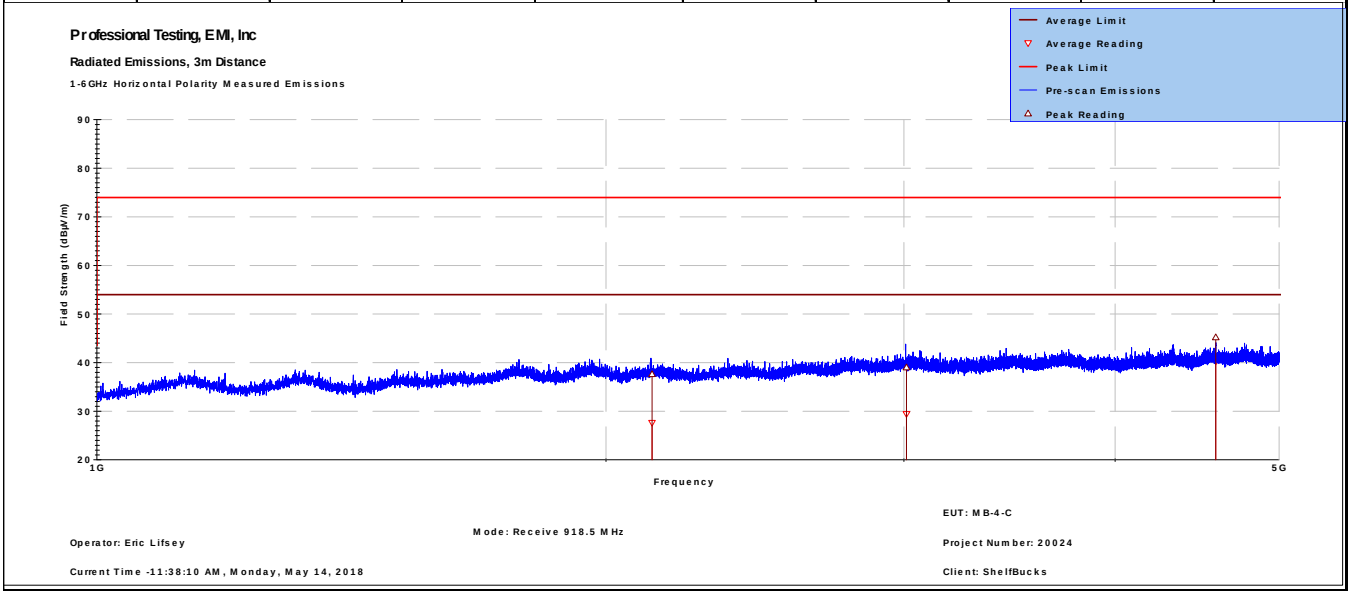
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4: 2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
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):	5/14/2018	**EUT Serial #:**	0
Customer:	ShelfBucks	**EUT Part #:**	MB-4-C
Project Number:	20024	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MB-4-C	**Witness' Name:**	Devin Murphy

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Receive 918.5 MHz	

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
2129.4	3	311	1.02	Average	36.8	27.602	54.0	-26.4	Pass
3010.89	3	305	2.11	Average	36.4	29.425	54.0	-24.5	Pass
4587.44	3	226	1.3	Average	44.5	40.234	54.0	-13.7	Pass



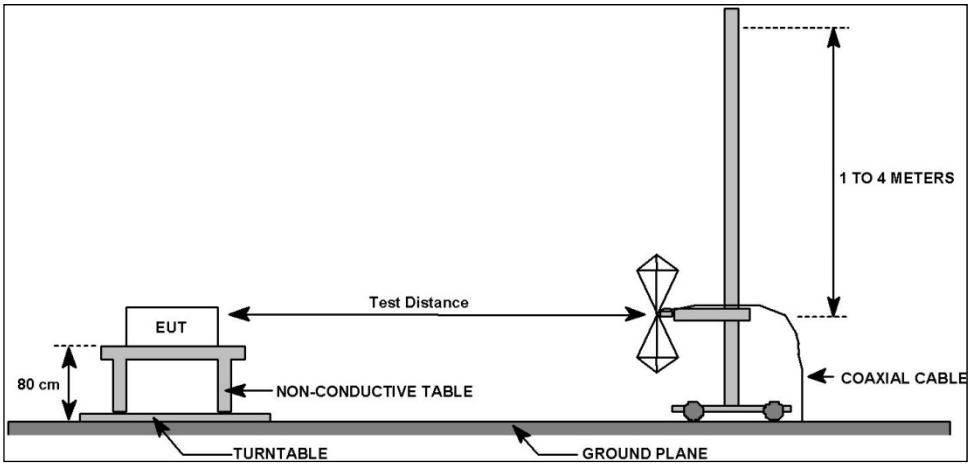
> 1GHz Horizontal Antenna Polarity Measured Emissions

7.0 Radiated Spurious Emissions, Transmit Mode

7.1 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.



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	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	14 May 2018

7.3 Test Results

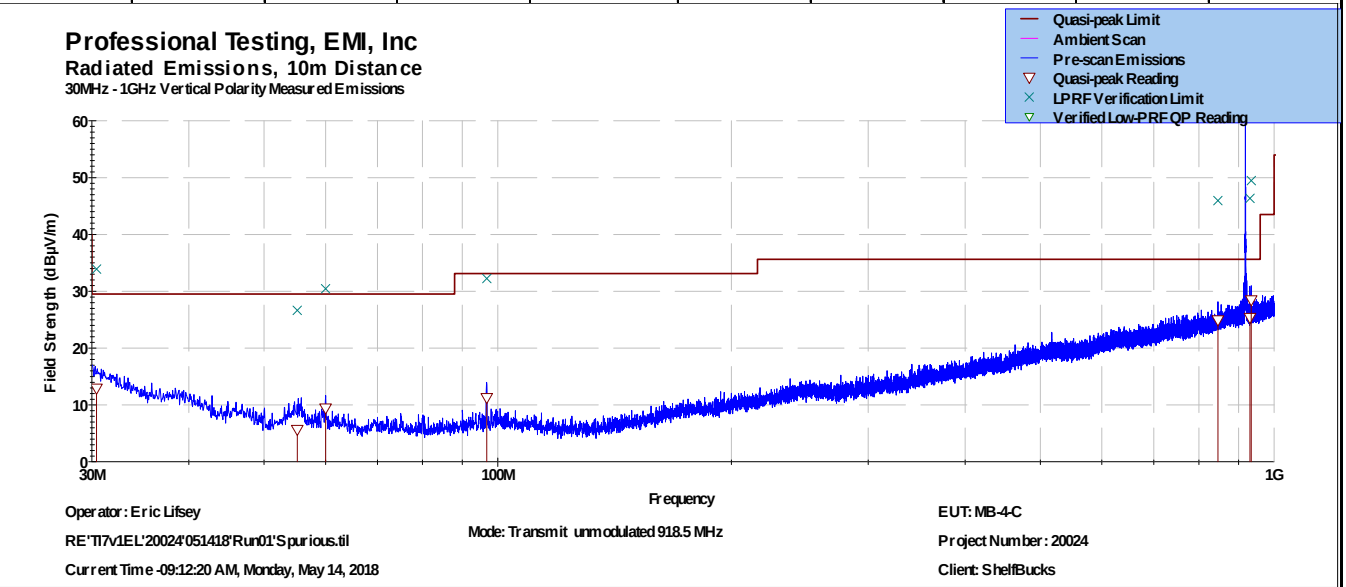
The duty cycle averaging factor applies -20.0 dB to the peaks recorded for the harmonics. As all peaks were below the peak limit, the averaged emissions are also below the average limit.

7.3.1 Up to 1 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
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):	5/14/2018	EUT Serial #:	0
Customer:	ShelfBucks	EUT Part #:	MB-4-C
Project Number:	20024	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	MB-4-C	Witness' Name:	Devin Murphy

Radiated Emissions Test Results Data Sheet			Page: 1 of 1
EUT Line Voltage:	3 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Transmit unmodulated 918.5 MHz	

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
30.423	10	28	3.91	Quasi-peak	24.105	12.895	29.5	-16.6	Pass
55.168	10	285	3.63	Quasi-peak	25.002	5.641	29.5	-23.9	Pass
59.999	10	309	3.99	Quasi-peak	29.24	9.429	29.5	-20.1	Pass
96.805	10	125	1.52	Quasi-peak	29.628	11.244	33.1	-21.9	Pass
846.521	10	99	3.9	Quasi-peak	22.509	24.923	35.6	-10.7	Pass
931.238	10	136	3.52	Quasi-peak	21.168	25.349	35.6	-10.3	Pass
934.552	10	157	3.27	Quasi-peak	24.2	28.465	35.6	-7.1	Pass



≤ 1GHz Vertical Antenna Polarity Measured Emissions

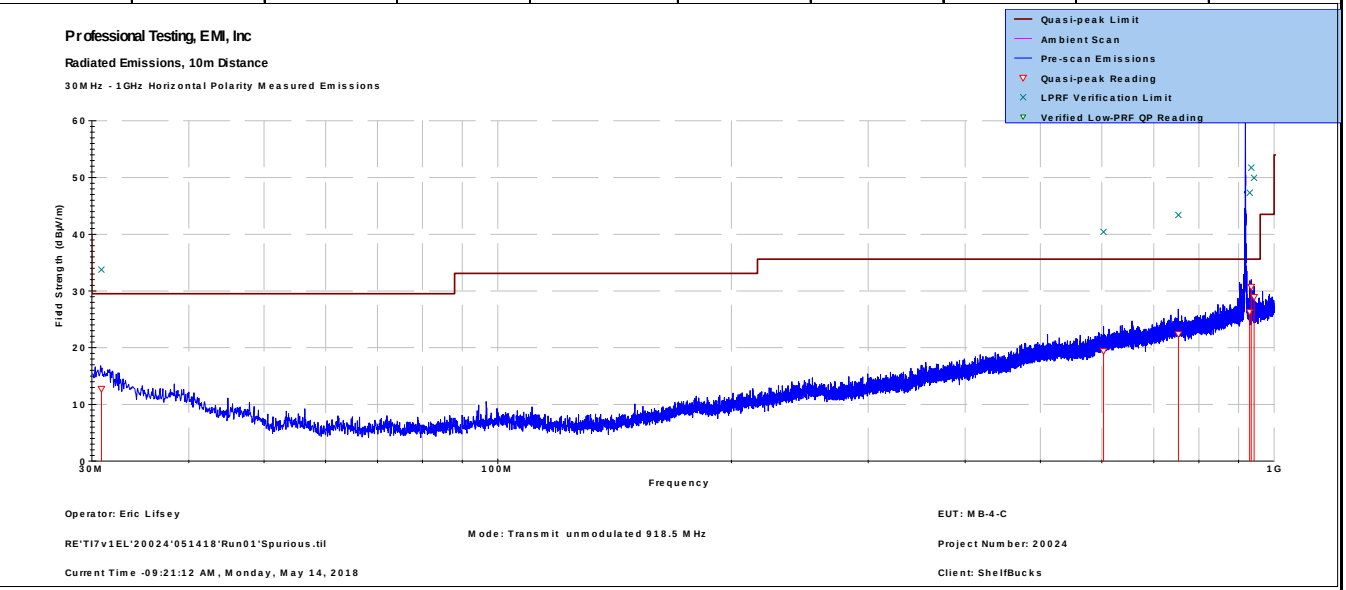
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
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):	5/14/2018	**EUT Serial #:**	0
Customer:	ShelfBucks	**EUT Part #:**	MB-4-C
Project Number:	20024	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MB-4-C	**Witness' Name:**	Devin Murphy

Radiated Emissions Test Results Data Sheet — **Page: 1 of 1**

EUT Line Voltage:	3 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	30MHz to 1GHz
EUT Mode of Operation:		Transmit unmodulated 918.5 MHz	

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
30.862	10	65	2.49	Quasi-peak	24.141	12.747	29.5	-16.8	Pass
602.946	10	342	1.68	Quasi-peak	21.956	19.397	35.6	-16.2	Pass
753.102	10	269	1.37	Quasi-peak	21.675	22.396	35.6	-13.2	Pass
930.436	10	283	1.12	Quasi-peak	22.142	26.303	35.6	-9.3	Pass
934.524	10	259	1.23	Quasi-peak	26.475	30.739	35.6	-4.9	Pass
942.506	10	275	1.38	Quasi-peak	24.475	28.94	35.6	-6.7	Pass



≤ 1GHz Horizontal Antenna Polarity Measured Emissions

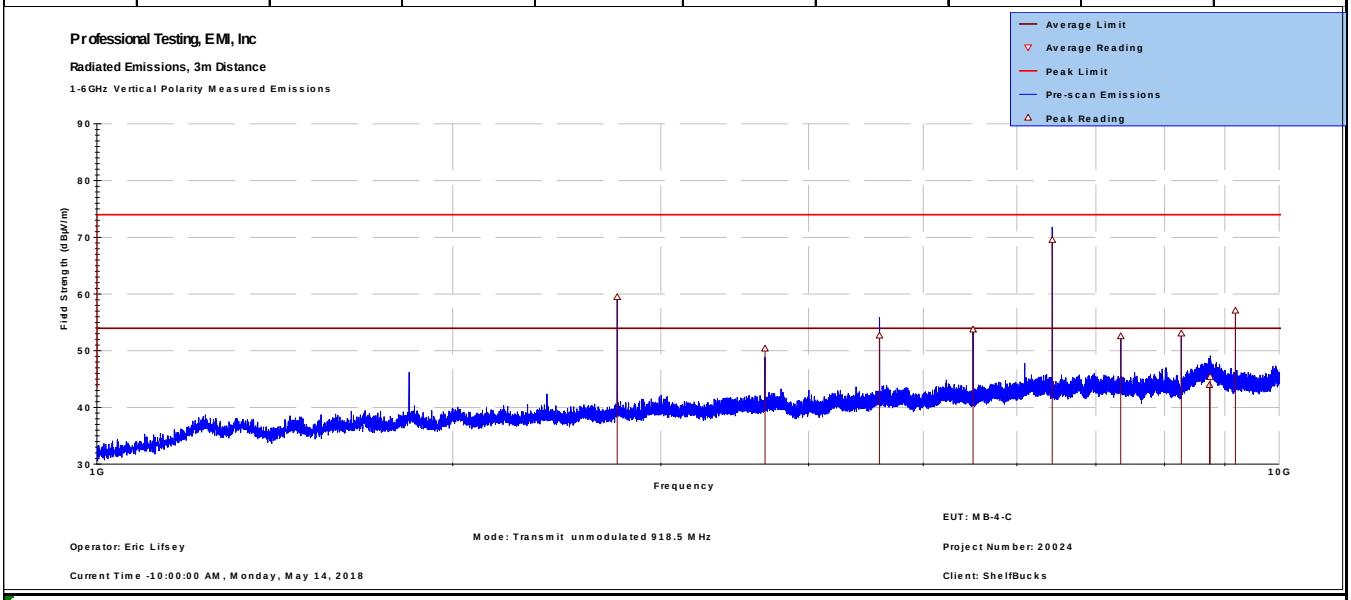
7.3.2 Up to 10 GHz

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
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):	5/14/2018	EUT Serial #:	0
Customer:	ShelfBucks	EUT Part #:	MB-4-C
Project Number:	20024	Test Technician:	Eric Lifsey
Purchase Order #:	NA	Supervisor:	Lisa Arndt
Equip. Under Test:	MB-4-C	Witness' Name:	Devin Murphy

Radiated Emissions Test Results Data Sheet — Page: 1 of 1

EUT Line Voltage:	3 VDC	EUT Power Frequency:	0 N/A
Antenna Orientation:	Vertical	Frequency Range:	Above 1GHz
EUT Mode of Operation:		Transmit unmodulated 918.5 MHz	

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
2755.52	3	82	2.01	Peak	67.2	59.444	74.0	-14.5	Pass
3674.02	3	234	2.78	Peak	57.1	50.355	74.0	-23.6	Pass
4592.53	3	193	3.06	Peak	56.9	52.638	74.0	-21.3	Pass
5511.03	3	272	1.09	Peak	56.1	53.733	74.0	-20.2	Pass
6429.51	3	257	1.11	Peak	68.5	69.519	74.0	-4.4	Pass
7347.99	3	143	1.11	Peak	48.8	52.553	74.0	-21.4	Pass
8266.53	3	10	2.55	Peak	47.3	52.999	74.0	-21.0	Pass
8731.41	3	37	3.85	Peak	35.4	43.931	74.0	-30.0	Pass
8745.32	3	98	3.52	Peak	36.8	45.377	74.0	-28.6	Pass
9185.01	3	3	1.76	Peak	48.5	57.059	74.0	-16.9	Pass



> 1GHz Vertical Antenna Polarity Measured Emissions

Professional Testing, EMI, Inc.

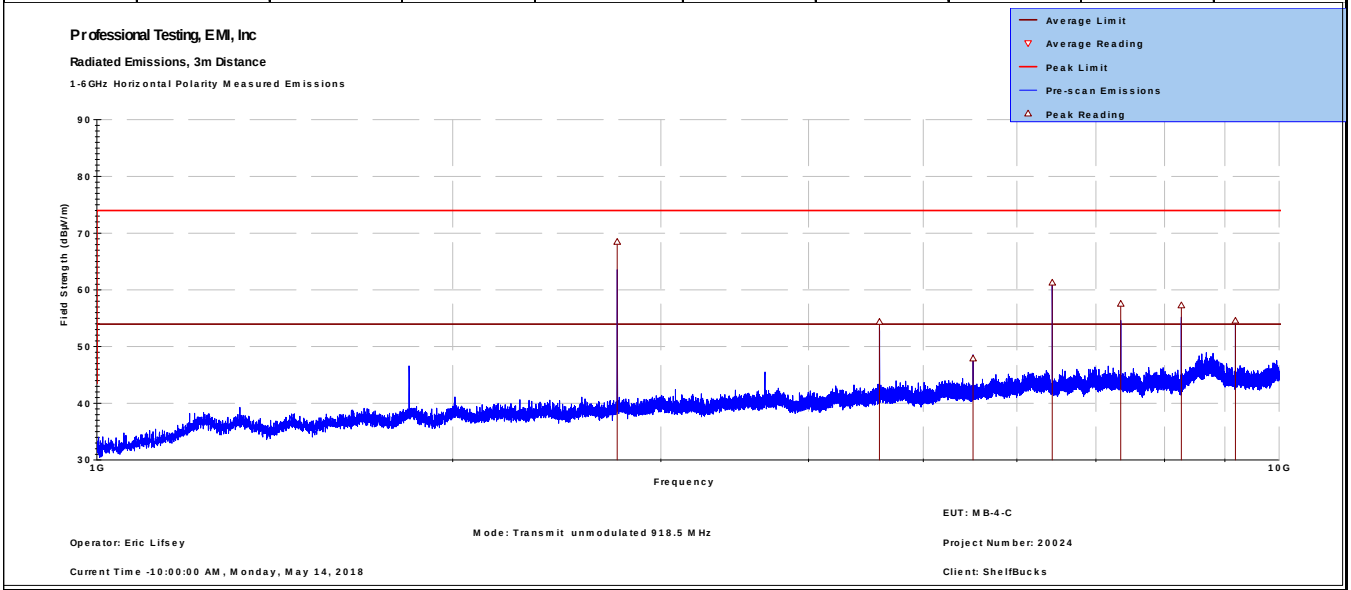
Test Method:	ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	5/14/2018	**EUT Serial #:**	0
Customer:	ShelfBucks	**EUT Part #:**	MB-4-C
Project Number:	20024	**Test Technician:**	Eric Lifsey
Purchase Order #:	NA	**Supervisor:**	Lisa Arndt
Equip. Under Test:	MB-4-C	**Witness' Name:**	Devin Murphy

Radiated Emissions Test Results Data Sheet

Page: 1 of 1

EUT Line Voltage:	3 VDC	**EUT Power Frequency:**	0 N/A
Antenna Orientation:	Horizontal	**Frequency Range:**	Above 1GHz
EUT Mode of Operation:		Transmit unmodulated 918.5 MHz	

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
2755.49	3	230	1.65	Peak	76.2	68.447	74.0	-5.5	Pass
4592.56	3	205	3.6	Peak	58.6	54.346	74.0	-19.6	Pass
5511.12	3	300	3.82	Peak	50.2	47.864	74.0	-26.1	Pass
6429.47	3	313	1.82	Peak	60.2	61.257	74.0	-12.7	Pass
7347.94	3	281	2.46	Peak	53.8	57.538	74.0	-16.4	Pass
8266.56	3	283	2.2	Peak	51.5	57.239	74.0	-16.7	Pass
9185.13	3	280	3.22	Peak	46	54.525	74.0	-19.4	Pass



> 1GHz Horizontal Antenna Polarity Measured Emissions

8.0 Antenna Construction Requirements

8.1 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.

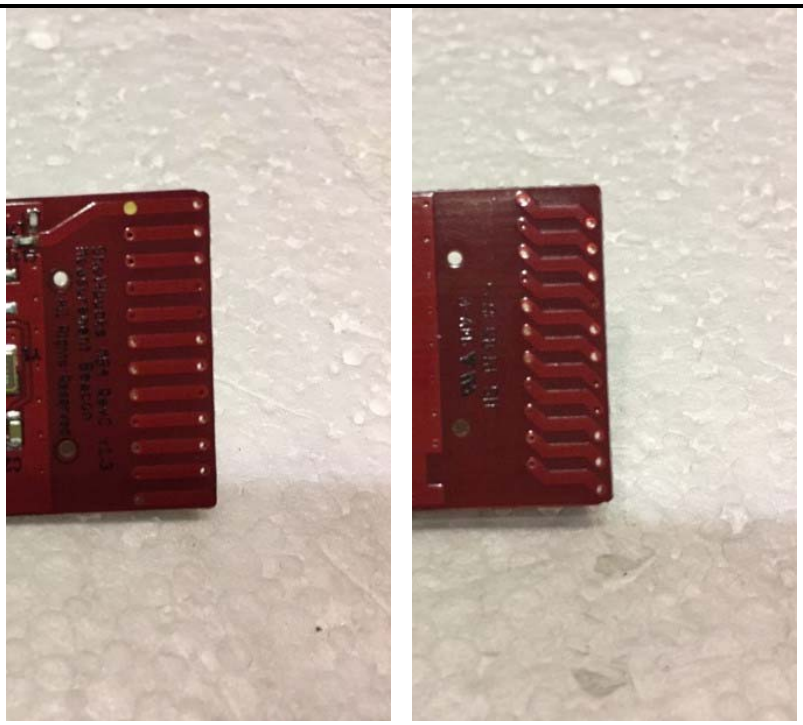
8.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	14 May 2018

8.3 Results

Table 10.3.1 Antenna Construction Details

Manufacturer: Shelfbucks



Antenna Construction
Top & Bottom view of PCB

- Antenna is a shortened linear-loaded monopole etched onto the circuit board.
- The UF.L connector used for conducted measurements is not present in the finished product.
- Gain is 0 dBi.

The antenna design above satisfies the requirements of the rules.

9.0 Equipment

9.1 Radiated Emissions 30 MHz to 10 GHz

Radiated Emissions Test Equipment List					
Tile! Software Version:		**Version: 7.1.2.17 (Jan 08, 2016 - 02:12:48 PM) or 4.1.A.0, April 14, 2009, 11:01:00PM**			
Test Profile:		**2018_Radiated Emissions_TILE7_v1EL.til**			
Asset #	**Manufacturer**	**Model**	**Equipment Nomenclature**	**Serial Number**	**Calibration Due Date**
1509A	Braden	TDK 10M	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	7/10/2019
1890	HP	8447F-H64	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/10/2020
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	11/7/2018
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	3/7/2019
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	TDK 10M	TDK 10M Chamber,sVSWR > 1 GHz	DAC-012915-005	11/16/2019
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/10/2020
C030	none	none	Cable Coax, N-N, 30m, 30 MHz - 18GHz	none	9/28/2018
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	3/15/2019

9.2 Bandwidth, Power, Power Spectral Density, and Duty Cycle

Asset #	Manufacturer	Model #	Description	Calibration Due
2295	Agilent	E4440A	Spectrum Analyzer	19 Dec 2018

9.3 Other

Asset #	Manufacturer	Model #	Description	Calibration Due
1443	HP	6215A	Adjustable Linear Power Supply	CIU

10.0 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.

Specific wireless parameter tests such as power or bandwidth may cite different settings than listed above.

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