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

Written by

Larry Finn Chief Technical Officer Eric Lifsey EMC Engineer

Revision History

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

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None.

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Compliance Certificate

Applicant	Device & Test Identification	
Shelfbucks, Inc.	FCC ID:	2ALSL-MB-4-C
2500 Bee Caves Rd Bldg.2, Suite 240	Industry Canada ID:	N/A
Austin, TX 78746	Model(s):	MB-4-C
Certificate Date: 14 May 2018	Laboratory Project ID:	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 <u>902-928 MHz</u> , 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.



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.

Representativ	e 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:

Conducted mains levels are determined as follows:

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

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

1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable Documents			
Document	Title		
47 CFR	Part 15 – Radio Frequency Devices		
47 CFK	Subpart C -Intentional Radiators		
RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-		
N33-247 ISSUE 2	Exempt Local Area Network (LE-LAN) Devices		
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus		
ANCI C62 10,2012	American National Standard of Procedures for Compliance Testing of Unlicensed		
ANSI C63.10:2013	Wireless Devices		

Table 1.7.2: Applicable Clauses				
Parameter	FCC Part 15	IC RSS References		
raidiletei	Rule Paragraphs	ic N33 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	Date		
	Fundamental Power		
15.247(a)(3) //	Conducted Limits	14 May 2019	
RSS-247 5.2	1 W (30 dBm)	14 May 2018	
	Limit Restated as Field: 125.23 dBμV/m @ 3 m		

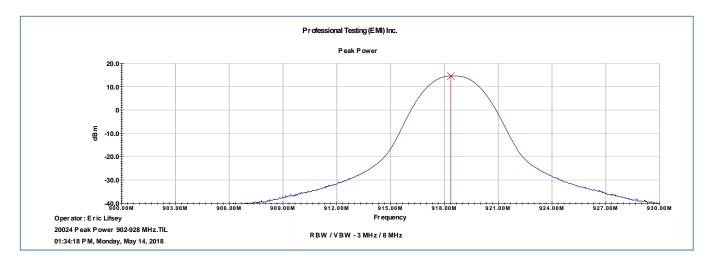
2.3 Test Results, Peak Power

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

Table 2.3.1 Power, Peak, Conducted					
Frequency Measured Peak Power Measured Peak Power					
MHz	in dBm	in mW			
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

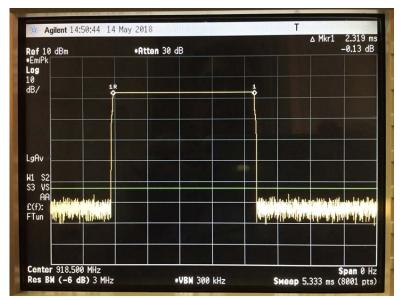
Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power.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

Table 2.4.1 Du	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							

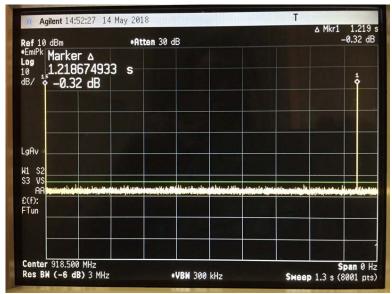
Factor for averaging exposure: -32.7 / 2 = 16.35 dB

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

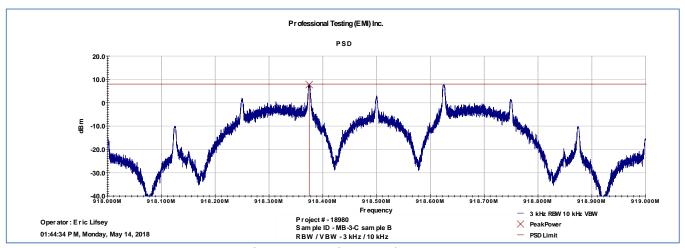
A spectrum analyzer is either connected directly to the EUT or used by radiated means to measure the fundamental emission. It is adjusted to measure the power spectral density in the specified resolution bandwidth.

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)	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

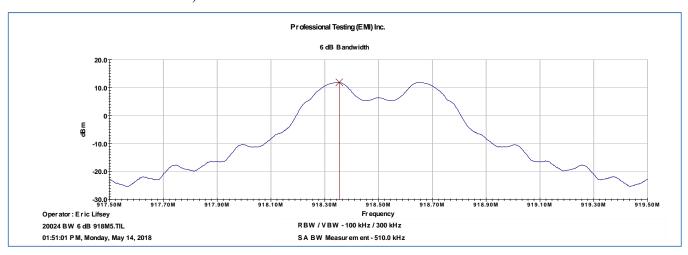
The bandwidth measurement is used to verify DTS characteristics and/or for general reporting for agency application.

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

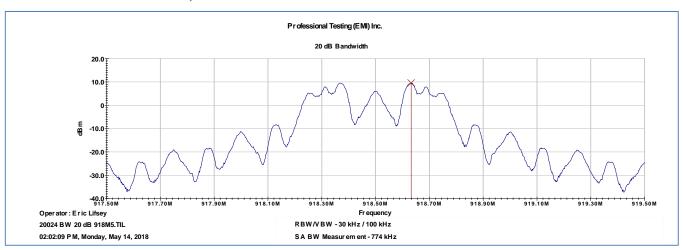
Table 4.3.1 Band	dwidth							
Bandwidth 6 dB, Minimum 500 kHz in 100 kHz RBW								
	Channel		Reported					
	Measured BW		Minimum BW					
	(kHz)		(kHz)					
	510		510					
Bandwidth 20 dB, Measure and Report								
	Channel		Reported					
	Measured BW		Maximum BW					
	(kHz)		(kHz)					
	774		774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

Plotted measurements appear on the following pages.

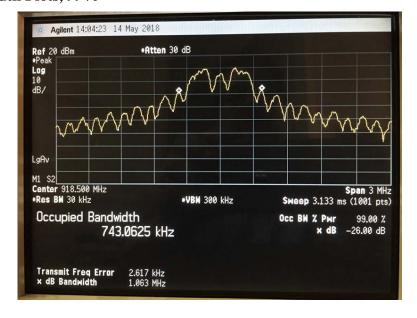
4.3.1 Bandwidth Plots, 6 dB



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

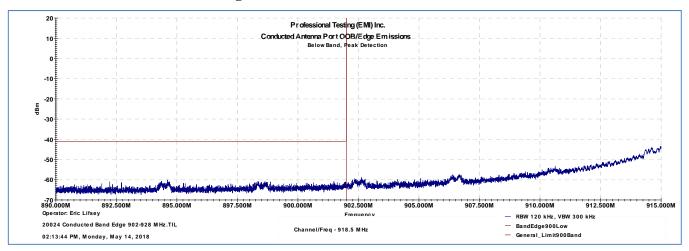
47 CFR (USA) // IC (Canada)	47 CFR (USA) // IC (Canada)							
Section Reference	Parameter	Date(s)						
15.247, 15.205 //	Unwanted Emissions Adjacent to Authorized	14 May 2019						
RSS-247 5.5, RSS-Gen 4.9	Band, Radiated	14 May 2018						

5.3 Test Results

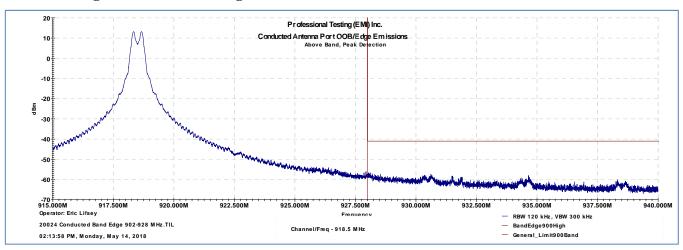
Measurements included more than 2 standard bandwidths (standard bandwidth 120 kHz) from the band edges to provide a clear view of the fundamental and the declining emission levels. Peak detection with max-hold was employed for a conducted measurement.

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

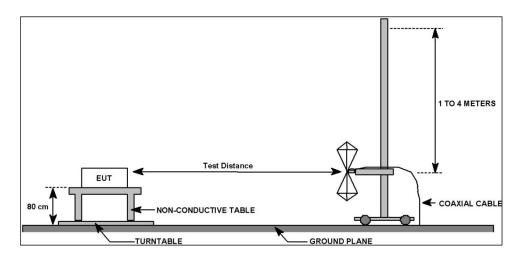


6.0 Radiated Spurious Emissions, Receive Mode

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

	Method:	pment in the I			dio-Noise Fm			
	cordance with:	ions Part 47, S		to 40 GHz	uio ivoise Liii	issions from		
			Subpart B - Un	intentional Ra	adiators, Radi	ated		
	on:							
est Date(s): 5/14/2018 EUT Serial #: 0 ustomer: ShelfBucks EUT Part #: M								
	omer:	EUT Part #:		MB-4-C				
	ect Number:	Test Techni		Eric Lifsey				
	hase Order #:	Supervisor:		Lisa Arndt				
	p. Under Test:	Witness' Na	ame:	Devin Murp	ohy			
ons Test Results Data		Sheet		Pa	ge: 1	of 1		
VDC	EUT Line Voltag	EUT Pow	er Frequen	cy: C	N/A			
Vertical	ntenna Orientat	Freque	ency Range:		30MHz to	1GHz		
ion:	EUT		Rec	eive 918.5 N	ЛHz			
ntenna Detector Function	uency Test sured Distance IHz) (Meters)	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results		
2.96 Quasi-peak	433 10	24.12	12.906	29.5	-16.6	Pass		
3.55 Quasi-peak	.97 10	25.014	5.585	29.5	-23.9	Pass		
1.28 Quasi-peak	664 10	30.361	11.962	33.1	-21.1	Pass		
1.54 Quasi-peak	371 10	21.38	22.776	35.6	-12.8	Pass		
3.03 Quasi-peak	.934 10	21.081	24.888	35.6	-10.7	Pass		
3.8 Quasi-peak	.971 10	21.058	25.308	35.6	-10.3	Pass		
	Professional Te Radiated Emissio 30MHz - 1GHz Vertical Pdat			— Ami — Pre ▽ Qua × LPR	si-peak Limit bient Scan scan Emissions si-peak Reading IF Verification Limit fifed Low-PRFQP Ri	eading		
	40				*	×		
100M	10 30M	And the second s	A STATE OF THE STA			1G		
•	0		Frequency	Frequency E Mode: Receive 918.5 MHz P	Frequency EUT: MB-4-C	Frequency EUT: MB-4-C Mode: Receive 918.5 MHz Project Number: 20024		

≤ 1GHz Vertical Antenna Polarity Measured Emissions

									S	helfbucks, I	nc. – M	IB-4-C
				Profess	sional Te	sting, EN	VII, Inc.					
Test Metho	od:				n National Star Electronic Equi					dio-Noise Em	issions 1	from
In accordar	nce with:	FCC Pa			Federal Regulat	ions Part 47, S	Subpart B - Ur	nintenti	onal Ra	diators, Radi	ated	
Section:		15.109				T						
Test Date(s	<u>s):</u>	5/14/				EUT Serial		0				
Customer:		ShelfE				EUT Part #:		MB-4				
Project Nur Purchase O		20024 NA				Test Techni Supervisor:		Eric L Lisa A				
Equip. Und		MB-4-	.r			Witness' N		_	Murp	hv		
Equip. Ona				issions Test	Results Data		<u> </u>	Devii	Pag		of	1
EUT Li	ine Voltage	:	3	3 VDC		EUT Pow	er Frequen	icy:	0	_		
Antenna	a Orientatio	on:		Horizor	ntal	Frequ	ency Range	:	30MHz to 1GH			
	EUT N	∕lode o	f Ope	eration:			Rec	eive 9	18.5 N	1Hz		
Frequency Measured (MHz)	Test Distance (Meters)	EU Direc (Degr	tion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ\		Margin (dB)	Test Ro	esults
30.948	10	88	3	3.37	Quasi-peak	24.16	12.728	29).5	-16.8	Pas	ss
526.537	10	8		1.49	Quasi-peak	22.201	17.798	35		-17.8	Pas	SS
700.443	10	17		1.83	Quasi-peak	21.826	20.98	_	5.6	-14.6	Pa	
873.106	10	22		2.89	Quasi-peak	21.33	24.684		5.6	-10.9	Pas	
885.573 961.762	10 10	17 14	_	3.92 1.13	Quasi-peak Quasi-peak	21.328	24.838 25.916	43	5.6	-10.8 -17.6	Pa: Pa:	
901.702	10	14	.9	1.13	Quasi-peak	20.900	23.910	43		-17.0	ra.	33
Radiated En	nal Testing, EMI, Inc nissions, 10m Distanc Hz Horizontal Polarity I		issions						∇ Quasi-p × LPRF Ve			
50 (a) (a) (b) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c									×	*	×××	
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30 M	be langua		kking/allphi	100M							16	
Operator: Eri RE'TI7v1EL'	ic Lifsey 20024'051418'Run02' e -11:11:03 AM, Monda	-			Frequ	iency	P	EUT: MB-4-C Project Numb Client: ShelfB			16	
			≤ 1GI	Hz Horizont	al Antenna P	olarity Mea	sured Emis	sions				

6.3.2 Up to 5 GHz

			Profess	sional Te	sting, EN	VII, Inc.				
Test Metho	d:			n National Star Electronic Equi					io-Noise En	nissions from
In accordan	ce with:	FCC Part 15.2 Emissions Lir		ederal Regula	tions Part 47, S	Subpart B - Ur	intenti	ional Rad	liators, Rad	iated
Section:		15.109								
Test Date(s	<u>):</u>	5/14/2018			EUT Serial		0			
Customer:		ShelfBucks			EUT Part #:		MB-4			
Project Nur		20024			Test Techni		Eric L			
Purchase O		NA			Supervisor:		Lisa A			
Equip. Und	er Test:	MB-4-C			Witness' N	ame:	Devir	1 Murp	hy	
	F	Radiated Em	nissions Test	Results Dat	a Sheet			Pag	e: 1	of 1
EUT Li	ne Voltage	:	3 VDC		EUT Pow	er Frequen	су:	0	N/A	
Antenna	Orientatio	n:	Vertic	al	Frequ	ency Range:	:		Above 1	GHz
	EUT N	/lode of Op	eration:			Rec	eive 9	18.5 M	Hz	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ	Level V/m)	Margin (dB)	Test Resul
1919.96	3	277	2.27	Average	43.1	33.774	54	1.0	-20.2	Pass
2982.15	3	218	1.94	Average	36.2	29.235	54	1.0	-24.7	Pass
4587.52	3	170	1.47	Average	42.5	38.199	54.0		-15.8	Pass
Radiated Em	al Testing, EMI, Inc nissions, 3m Distance cal Polarity Measured							— Average ✓ Average — Peak Lir — Pre-scar Δ Peak Re	Reading nit Emissions	
20 ±				Fred	uency	l l				5 G
Operator: Eric			Mode: Rec	eive 918.5 M Hz	•	ı	EUT: M B-4-C Project Num I			
Current Time	-11:38:10 AM, Monda	ay, May 14, 2018				(Client: Shelfl	Bucks		

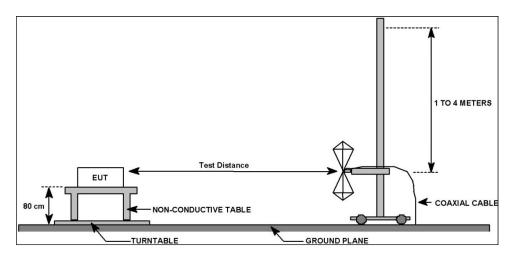
												3-4-0
				Profess	ional Te	sting, EN	VII, Inc.					
est Metho	d:				n National Star Electronic Equi					lio-Noise Em	issions fro	om
n accordan	ce with:	FCC Pa			ederal Regulat	ions Part 47,	Subpart B - Un	intenti	onal Rad	diators, Radi	ated	
ection:		15.109)									
est Date(s)):	5/14/	2018		0							
Customer: ShelfBucks						EUT Part #:		MB-4	-C			
Project Nun	nber:	20024				Test Techn	ician:	Eric L	ifsey			
urchase O	rder #:	NA				Supervisor		Lisa A	rndt			
quip. Unde	er Test:	MB-4-	·C			Witness' N	ame:	Devin	Murp	hy		
	R	Radiate	ed Em	issions Test	Results Data	Sheet			Pag	e: 1	of	1
EUT Li	ne Voltage:		3	VDC		EUT Pov	ver Frequen	су:	0	N/A		
Antenna	Orientatio	n:		Horizon	tal	Frequ	ency Range:			Above 1	GHz	
	EUT N	/lode o	f Ope	ration:			Rec	eive 9	18.5 M	Hz		
Frequency Measured (MHz)	Test Distance (Meters)	EU Direc (Degr	tion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ\		Margin (dB)	Test Res	ults
2129.4	3	31	1	1.02	Average	36.8	27.602	54	.0	-26.4	Pass	;
3010.89	3	30	5	2.11	Average	36.4	29.425	54	1.0	-24.5	Pass	;
4587.44	3	22	6	1.3	Average	44.5	40.234	54.0		-13.7	Pass	j
Radiated Em	ni Testing, EMI, Inc issions, 3m Distance ontal Polarity Measure	ed Emission:	S						— Average ▼ Average — Peak Lin — Pre-scan Δ Peak Re	Reading mit n Emissions		
10 40 40 40 40 40 40 40 40 40 40 40 40 40	against an de de la company de	and the design	nde di sodi	d to the second		on planting by the beautiful property			ether Just behave	Harten to the standard		
Operator: Eric	Lifsey -11:38:10 AM, Monda	ıy, May 14, 2	018	Mode: Rec	Freq≀ ∋ive 918.5 M Hz	iency	F	EUT: M B-4-C Project Num b Client: Shelff				
			> 1GI	Hz Horizont	al Antenna P	olarity Mea	sured Emis	sions				_

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

				Profes	sional Te	sting, El	MI, Inc.				
Test Me	thod:		ANSI C63.10 Devices	: 2013: Ameri	can National St	andard of Prod	cedures for Co	mpliance	e Testin	g of Unlicer	nsed Wirele
In accor	dance v	with:	FCC Part 15. Limits	209 - Code of	Federal Regulat	ions Part 47,	Subpart C - Int	tentional	Radiate	ors, Radiate	d Emission
Section:			15.209					_			
Test Dat	te(s):		5/14/2018			EUT Serial	#:	0			
Custom	er:		ShelfBucks	i		EUT Part #:	•	MB-4-0	<u> </u>		
Project	Numbe	r:	20024			Test Techn	ician:	Eric Life	sey		
Purchas	e Orde	r #:	NA			Supervisor		Lisa Ar	ndt		
Equip. L	Jnder T	est:	MB-4-C			Witness' N	ame:	Devin I	Murph	ıy	
		F	Radiated En	nissions Tes	t Results Data	a Sheet			Page	: 1	of 1
EU	T Line \	/oltage	:	3 VDC		EUT Pov	ver Frequen	су:	0	N/A	
Ante	nna Or	ientatio	on:	Vertic	cal	Frequ	ency Range	:	3	0MHz to	1GHz
		EUT N	/lode of Op	eration:			Transmit u	nmodul	ated 9	18.5 MHz	:
Frequen	су	Test	EUT	Antenna		Recorded	Corrected				
Measur	ed Di	stance	Direction	Height	Detector	Amplitude	Level	Limit Le		Margin	Test Resu
(MHz)	(N	leters)	(Degrees)	(Meters)	Function	(dBµV)	(dBµV/m)	(dBμV)	/m)	(dB)	
30.423	3	10	28	3.91	Quasi-peak	24.105	12.895	29.5	5	-16.6	Pass
55.168	3	10	285	3.63	Quasi-peak	25.002	5.641	29.5	5	-23.9	Pass
59.999	9	10	309	3.99	Quasi-peak	29.24	9.429	29.5	5	-20.1	Pass
96.80	5	10	125	1.52	Quasi-peak	29.628	11.244	33.2	1	-21.9	Pass
846.52	1	10	99	3.9	Quasi-peak	22.509	24.923	35.6	5	-10.7	Pass
931.23	8	10	136	3.52	Quasi-peak	21.168	25.349	35.6	5	-10.3	Pass
934.55	2	10	157	3.27	Quasi-peak	24.2	28.465	35.6	5	-7.1	Pass
Rad	diated E Hz-1GHzVe	mission	sting, EMI, I s, 10m Distar y Measur ed Emissio	nce					— Ambie Pre-so ∇ Quasi- × LPRF	peak Limit int Scan an Emissions peak Reading Verification Limit d Low-PRF QP R	
£ 30				×							Land Alles
₩ S 20			×						Li Links	A Part of the Part	Y
Field	A And Company of the control of the	. – –		1		D. January	the state of the s	elling and the photos	And the second		
10	- destition	formula de la forta de la fort	Malandal Kinga Kinga Maranga M	alaski mirringi (Malana	tild alough an an difficulty belief the		The state of the s				
0 30	_				an district stands on a						
Oper	M ator:EricLit ⊓7∨1EL'2002∉		M'S perioes til	100M Mode: Tra	Fred ansmit unmodulated 91	quency 8.5 MHz		EUT: MB-4-C	00004		1 G
			on Spuillous.ui onday, May 14, 2018					Project Numb Client: ShelfB			

								Shelfbucks, I	nc. – MB-4-0
			Prof	essional Te	sting, El	VII, Inc.			
Test Metho	d:	ANSI C63 Devices	3.10: 2013: An	nerican National Sta	andard of Proc	edures for Co	mpliance Tes	ting of Unlice	nsed Wireless
In accordan	nce with:	FCC Part Limits	15.209 - Code	of Federal Regulat	ions Part 47,	Subpart C - In	tentional Rad	iators, Radiate	ed Emissions
Section:		15.209							
Test Date(s	<u>):</u>	5/14/2018 EUT Serial #: 0							
Customer:		ShelfBu	ıcks		EUT Part #:		MB-4-C		
Project Nur		20024			Test Techn		Eric Lifsey		
Purchase O		NA NA C			Supervisor		Lisa Arndt	l	
Equip. Und	er rest:	MB-4-C			Witness' N	ame:	Devin Mur	pny	
	F	Radiated	l Emissions 1	est Results Data	Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage	:	3 VI	OC .	EUT Pov	ver Frequen	cy:	0 N/A	
Antenna	orientation	n:	Hori	zontal	Frequ	ency Range	:	30MHz to	1GHz
	EUT N	∕lode of	Operation:			Transmit u	nmodulated	918.5 MHz	2
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degree	on Heigh	Detector t 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		26.303	35.6	-9.3	Pass
934.524	10	259		Quasi-peak		30.739	35.6	-4.9	Pass
942.506	10	275	1.38	Quasi-peak	24.475	28.94	35.6	-6.7	Pass
Radiated En	nal Testing, EMI, Inc nissions, 10m Distanc Hz Horizontal Polarity I		ions				— Ambi — Pre-s ▽ Quas × LPRF	i-peak Limit ent Scan can Emissions i-peak Reading Verification Limit ed Low-PRF QP Reading	
50 (W)/M 80 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9							and the state of t	×	×××××××××××××××××××××××××××××××××××××××
! when the second	Waternalan .				and a substitute of	the second second second second			
10	Agreemit of the Market State of the State of	officepropriate states and	Harrist House bearing by the	Anti-delision (m. 1911) India delision (m. 1911)					
0 T	-	-	11	OM Fre q	uency	-		#	1 G
Operator: Eri	c Lifsey		_			1	EUT: M B-4-C		
	20024'051418'Run01'			e: Transmit unmodulated 918.5	om Hz		Project Number: 20024		
Current Time	9 -09:21:12 AM, Monda	ay, May 14, 201	8				Client: ShelfBucks		
		≤	1GHz Horiz	ontal Antenna P	Polarity Mea	sured Emis	sions		

7.3.2 Up to 10 GHz

			Profess	sional Te	sting, El	MI, Inc.					
ANSI C63.10: 2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices											
n accordar	nce with:	FCC Part 15.2 Limits	:09 - Code of F	ederal Regulat	ions Part 47, S	Subpart C - Int	entional (Radiators, R	adiate	ed Emis	sions
Section: 15.209											
Test Date(s	s):	5/14/2018			EUT Serial		0				
Customer:		ShelfBucks			EUT Part #:		MB-4-C				
Project Nu		20024			Test Techn		Eric Lifs				
Purchase C Equip. Und		NA MB-4-C			Supervisor: Witness' N		Lisa Arr Devin N				
	F	Radiated Em	issions Test	Results Data	a Sheet			Page:	1	of	1
EUT L	ine Voltage:	: 3	S VDC		EUT Pow	ver Frequen	су:	0	N/A		
Antenna	a Orientatio	n:	Vertic	al	Frequ	ency Range:		Abo	ve 1	GHz	
	EUT N	Node of Ope	eration:			Transmit ui	nmodula	ated 918.5	МН	2	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Le (dBµV/		_	Test R	esults
2755.52	3	82	2.01	Peak	67.2	59.444	74.0	-14	1.5	Pa	ISS
3674.02	3	234	2.78	Peak	57.1	50.355	74.0	-23	3.6	Pa	ISS
4592.53	3	193	3.06	Peak	56.9	52.638	74.0			Pa	SS
5511.03	3	272	1.09	Peak	56.1	53.733	74.0	1		_	ISS
6429.51	3	257	1.11	Peak	68.5	69.519	74.0				ISS
7347.99	3	143	1.11	Peak	48.8	52.553	74.0			Pa	
8266.53	3	10 37	2.55 3.85	Peak Peak	47.3	52.999	74.0 74.0				ISS
8731.41 8745.32	3	98	3.52	Peak	35.4 36.8	43.931 45.377	74.0			Pa	ISS
9185.01	3	3	1.76	Peak	48.5	57.059	74.0			_	ISS
3103.01	3		1.70	i cak	40.5	37.033	74.0	, 10	<i></i>	1 0	33
Pr offessional Testing, E MI, Inc Radiated Emissions, 3m Distance 1-6 GHz Vertical Polarity Measured Emissions → Peak Limit → Pre-scan Emissions △ Peak Reading											
(g Bh//m)								<u> </u>			
(E/Mgp) the Bear of 60								^			<u> </u>
40		Marin Ma									
30 1G				Fre q	uency					10	G
Operator: Er		ıy, May 14, 2018	Mode: Tran	ismit unmodulated 918.:	5 M Hz	ı	EUT: M B-4-C Project Number: Client: ShelfBuck				

			Profess	sional Te	sting, El	MI, Inc.				
Test Metho	od:	ANSI C63.10 Devices	: 2013: Americ	can National St	andard of Prod	cedures for Co	mpliance Test	ing of Unlice	nsed Wireless	
In accordance with: FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits									ed Emissions	
Section:										
Test Date(s	s):	5/14/2018			EUT Serial		0			
Customer:		ShelfBucks			EUT Part #:		MB-4-C			
Project Nu		20024			Test Techn		Eric Lifsey			
Purchase C		NA			Supervisor		Lisa Arndt			
Equip. Und	ler Test:	MB-4-C			Witness' N	ame:	Devin Mur	ohy		
		Radiated Em	nissions Test	Results Dat	a Sheet		Pa	ge: 1	of 1	
EUT L	ine Voltage	:	3 VDC		EUT Pov	ver Frequen	cy: (N/A		
Antenna	a Orientatio	on:	Horizor	ntal	Frequ	ency Range		Above 1	GHz	
	EUT N	Mode of Ope	eration:			Transmit u	nmodulated	918.5 MHz	<u>.</u>	
Frequency	Test	EUT	Antenna	Detector	Recorded	Corrected	Limit Level	Margin		
Measured (MHz)	Distance (Meters)	Direction (Degrees)	Height (Meters)	Function	Amplitude (dBμV)	Level (dBµV/m)	(dBµV/m)	(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	
Radiated E	nal Testing, EMI, Inc missions, 3m Distance izontal Polarity Measu						— Peak I	ge Reading Limit an Emissions		
Fled Strength (dBM/m)						<u> </u>	Î Î			
50 — — 40 — —			والمراجع المراجع	makali ya kwanta ku wanaka di		and the same of th		Wilder of the Park		
30					HT:					
1 G				Freq	uency			,	10G	
							EUT: M B-4-C			

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



- 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							
Til	le! Software Version	on: Versio	n: 7.1.2.17 (Jan 08, 2016 - 02:12:48 PM)	or 4.1.A.0, April 14, 2	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	НР	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	НР	6215A	Adjustable Linear Power Supply	CIU

10.0 Measurement Bandwidths

Radiat	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
Padiated Emissions	30 to 1,000 MHz	10 m	4.8
Radiated Emissions	1 to 18 GHz	3 m	5.7

End of Report