Electromagnetic Compatibility Test Report

Prepared in accordance with

EN 55032:2012/AC:2013, CISPR 32:2015, CFR47 part 15B

On

Campfire BT Yoke

Prepared for:

Apricity Code
1001 SW Emkay Dr Ste 100
Bend, OR 97702
U.S.A

Prepared by:

TUV Rheinland of North America, Inc.
1279 Quarry Lane, Ste. A
Pleasanton, CA 94566 U.S.A.

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Revisions

Revision No.	Date	Reason for Change	Author
0	May 20, 2019	Original Document	BMJ

Note: Latest revision report will replace all previous reports.

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ATTESTATION OF TEST RESULTS

Client:	Apricity Code 1001 SW Emkay Dr Ste 100 Bend, OR 97702 U.S.A	Caitlin Metzger Tel. +1 541 204 4424 caitlin@apricitycode.com	
Model Name:	Campfire BT Yoke	***Serial Number:***	N/A
Model Numbers:	4000	***Date(s) Tested:***	March 12 to May 20, 2019
Test Location:	TUV Rheinland of North America 1279 Quarry Lane, Ste. A Pleasanton, CA 94566 U.S.A. Tel. (925) 249-9123		
Test Specifications:	Emissions:	EN 55032:2012/AC:2013, CISPR 32:2015, CFR47 part 15B	
	Immunity:	N/A	
Test Result:	**The above product was found to be Compliant to the above test standard(s)**		

Prepared by: Bernd Jungbluth	***Reviewed by:*** Josie Sabado
May 20, 2019 *Date* *Name* *Signature*	May 20, 2019 *Date* *Name* *Signature*
Other aspects: **None**	

PLEASANTON

US1131	**Testing Cert #3331.02**	**INDUSTRY CANADA 2932M-1**	**1097 (A-0268)**

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TABLE OF CONTENTS

1 GENERAL INFORMATION 5

1.1 SCOPE 5
1.2 PURPOSE 5
1.3 SUMMARY OF TEST RESULTS 6

2 LABORATORY INFORMATION 7

2.1 ACCREDITATIONS & ENDORSEMENTS 7
2.1 TEST FACILITIES 8
2.2 MEASUREMENT UNCERTAINTY 9
2.3 CALIBRATION TRACEABILITY 10
2.4 MEASUREMENT EQUIPMENT USED 11

3 PRODUCT INFORMATION 12

3.1 PRODUCT DESCRIPTION 12
3.2 EQUIPMENT MODIFICATIONS 12
3.3 TEST PLAN 12

4 EMISSIONS 16

4.1 RADIATED EMISSIONS 16

APPENDIX A 23

5 TEST PLAN 23

5.1 GENERAL INFORMATION 23
5.2 EUT DESIGNATION 23
5.3 TEST CONFIGURATIONS 23
5.4 EMISSIONS 27

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the listed standards based on the results of testing performed on March 12 to March 13, 2019 on Campfire BT Yoke, model number 4000, manufactured by Apricity Code. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

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1.3 Summary of Test Results

Applicant	Apricity Code 1001 SW Emkay Dr Ste 100 Bend, OR 97702 U.S.A
Contact	Caitlin Metzger
Tel.	+1 541 204 4424
E-mail	caitlin@apricitycode.com
Description	BT Module
Model Name	Campfire BT Yoke
Model Number	4000
Input Power	3.7 VDC, 15 mA (Battery operated)
Test Date(s)	March 12 to March 13 2019

Standards	Description	Severity Level or Limit	Criteria	Test Result
EN 55032:2012/AC:2013, CISPR 32:2015, CFR47 part 15B Product Family Standard Emissions	Information Technology Equipment – Radio Disturbance	See called out basic standards below	See Below	Complies
55032:2012, CISPR 32:2015, CFR47 part 15B	Radiated Emissions	CLASS B 30M-25GHZ	Limit	Complies

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2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 is recognized by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Pleasanton Registration No. US1131). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / A2LA

TUV Rheinland of North America EMC test facilities are accredited by the American Association for Laboratory Accreditation (A2LA). The laboratories have been assessed and accredited by A2LA in accordance with ISO Standard 17025:2005 (Testing Certificate #3331.02). The Scope of Laboratory Accreditation includes emission and immunity testing. The accreditations are updated annually.

2.1.3 Canada – Industry Canada

The Pleasanton 5-meter Semi-Anechoic Chamber, Registration No. 2932M-1, has been accepted by Industry Canada to perform testing to 3 and 5 meters based on the test procedures described in ANSI C63.4-2014. The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D-1, has been accepted by Industry Canada to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2014.

2.1.4 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

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2.1 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Pleasanton, California 94566, USA.

2.1.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 and 5 meters. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02). The 3/5-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter and 5 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

2.1.2 EMC Software - Pleasanton

Manufacturer	Name	Version	Test Type
ETS-Lindgren	TILE	3.4.K.14 @ 4.0.A.5	Radiated & Conducted Emissions
EMISoft	Vasona	5.0	Radiated & Conducted Emissions
Rohde & Schwarz	EMC32	10.40.10	Radiated Emissions
Agilent	Agilent MXE	A.11.02	Radiated & Conducted Emissions
ETS-Lindgren	TILE	3.4.K.14	Radiated & Conducted Immunity
Thermo Electron - Keytek	CEWare32	4.00	EFT/Surge/Voltage Dips & Interrupt
Voltech	IEC61000-3	1.21.07RC2	Harmonic & Flicker

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2.2 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities. The term standard uncertainty is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. The fraction may be viewed as the coverage probability or level of confidence of the interval.

2.2.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

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2.2.2 Measurement Uncertainty Emissions

Per CISPR 16-4-2	**U_{lab}**	**U_{cispr}**
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		

2.3 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

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2.4 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yy	Next Cal mm/dd/yy	Test
Bilog Antenna	Sunol Sciences	JB3	A102606	08/01/2018	08/01/2020	RE
Horn Antenna	EMCO	3115	9211-3969	05/16/2017	05/16/2019*	RE
Spectrum Analyzer	Agilent	N9038A	MY52260210	1/16/2019	1/16/2020	RE
Preamplifier	Miteq	AMF-7D-01001800-30-10p-L	2074297	N/A – (See Note 1)		RE
DC Block	Mini-Circuits	UNAT-1+	VUU83701027	N/A (See Note 1)		RE
Preamplifier	Sonoma Instruments	310N	185516	01/16/2019	01/16/2020	RE
Note 1: No calibration required. Path loss correction characterized internal. *Note 2: Horn antenna SN 9211-3969 utilized for radiated Band Edge measurements under laboratory declared 3 month extended calibration.						

Note: CE=Conducted Emissions, CI=Conducted Immunity, DP=Disturbance Power, EFT=Electrical Fast Transients, ESD=Electrostatic Discharge, FLI=Flicker, HAR=Harmonics, MF=Magnetic Field Immunity, NCR=No Calibration Required, RE=Radiated Emissions, RI=Radiated Immunity, SI=Surge Immunity, VDSI=Voltage Dips and Short Interruptions

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3 Product Information

3.1 Product Description

See Section 5.4.

3.2 Equipment Modifications

No modifications were needed to bring product into compliance.

3.3 Test Plan

The EUT product information, test configuration, mode of operation, test types, test procedures, test levels, pass/failure criteria, in this report were carried out per the product test plan located in Appendix A of this report.

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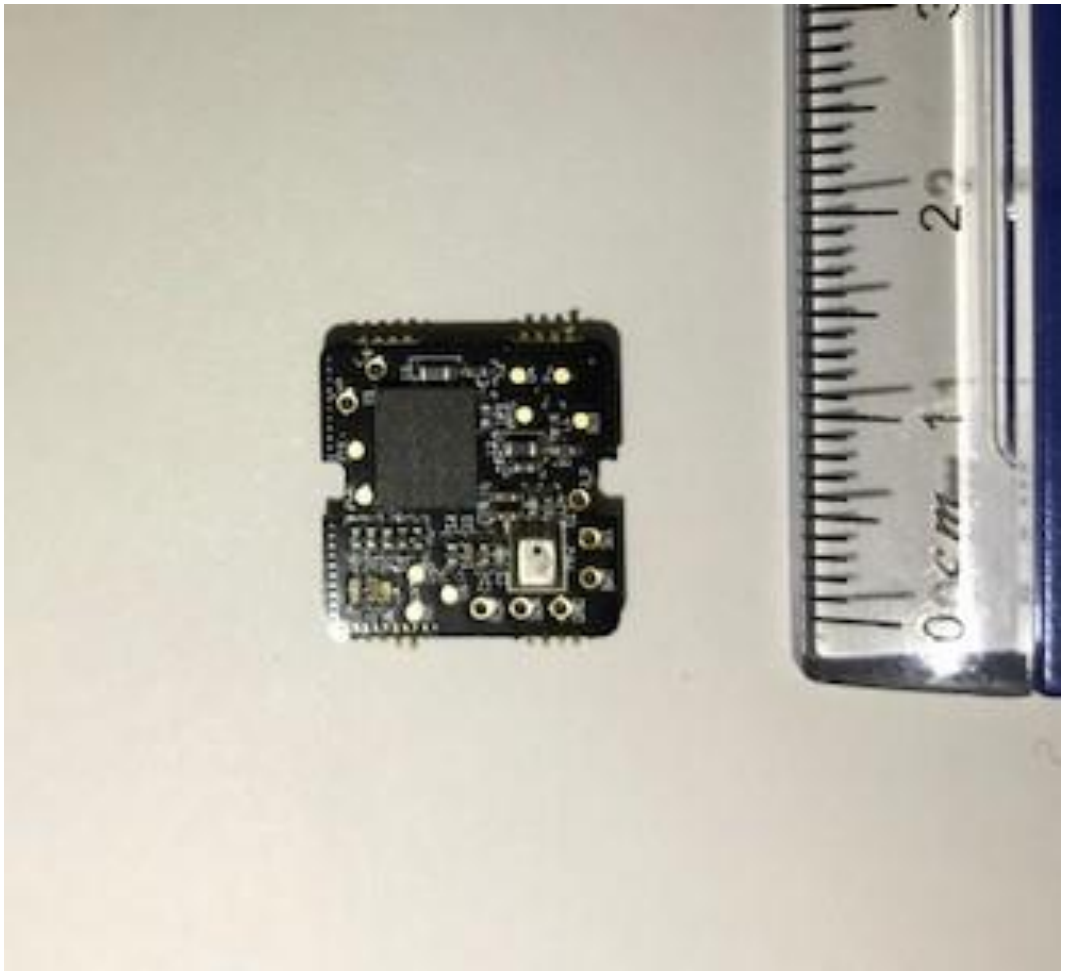

Figure 1: External Photo of Campfire BT Yoke - Top

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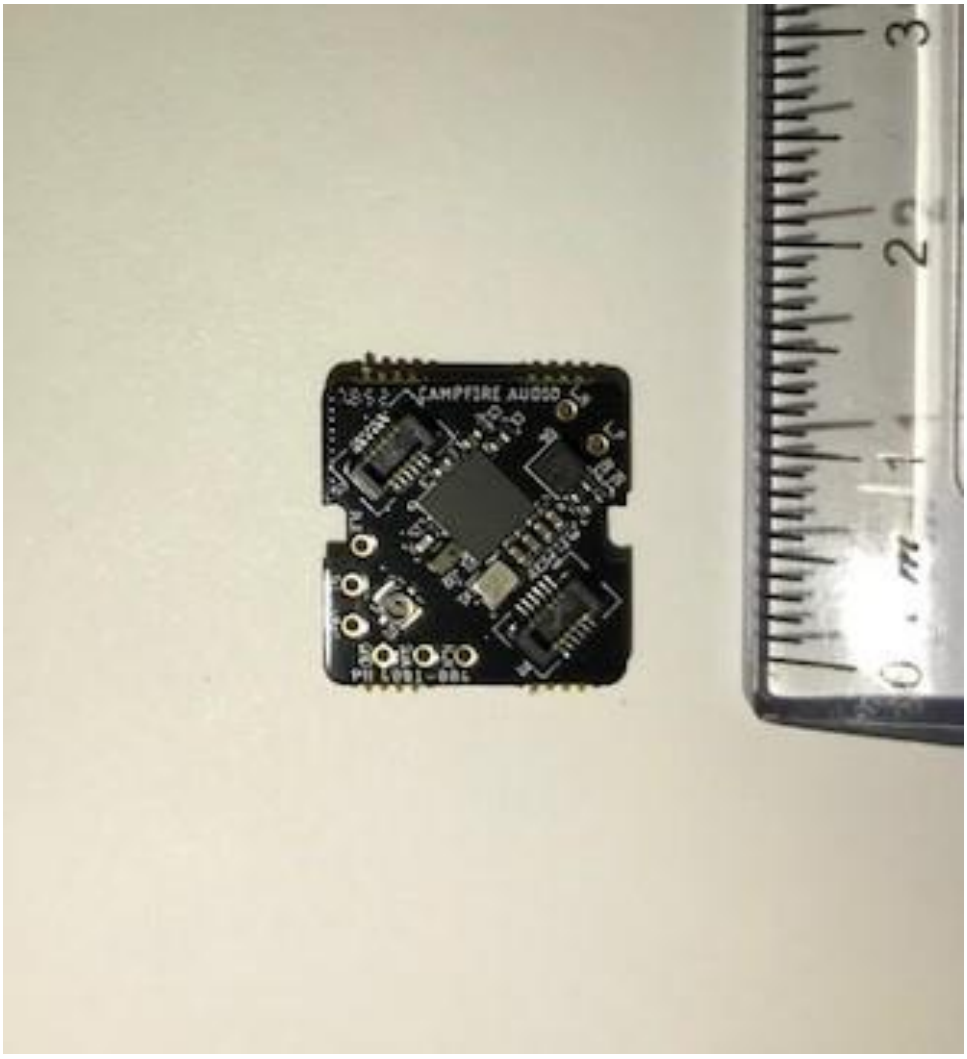

Figure 2: External Photo Campfire BT Yoke 4000– Rear

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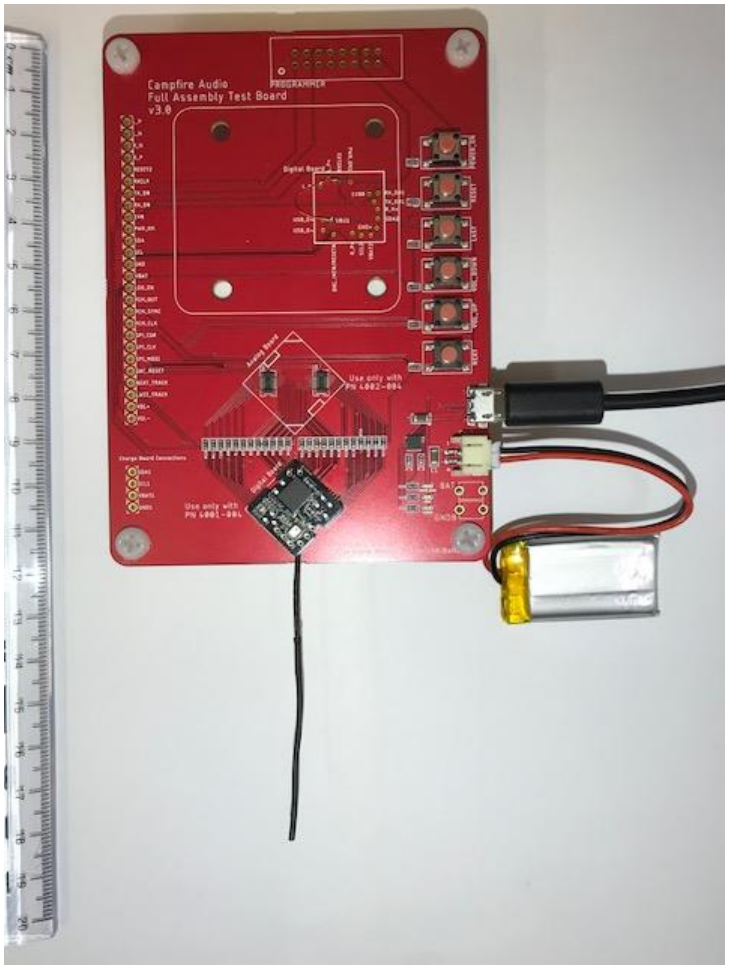

Figure 3: External Photo Campfire BT Yoke 4000 – Auxiliary board for radio configuration mounted – top

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4 Emissions

4.1 Radiated Emissions

This test measures the electromagnetic levels of spurious signals generated by the EUT that radiated from the EUT and may affect the performance of other nearby electronic equipment.

4.1.1 Overview of Test

Results	**Complies** (as tested per this report)			**Test Date(s)**		March 12 to March 20, 2019	
Standard	EN 55032:2012/AC:2013, CISPR 32:2015, CFR47 part 15B						
Model Number	Campfire BT Yoke			**Serial #**	N/A		
Configuration	See test plan for details.						
Test Setup	Tested in the 5-meter chamber, placed on turntable: see test plan for details.						
EUT Powered By	3.7 VDC, 15 mA (Battery operated)						
Environmental Conditions	March 12, 2019	**Temp**	20º C	**Humidity**	34%	**Pressure**	1012 mbar
	March 20, 2019	**Temp**	21º C	**Humidity**	35%	**Pressure**	1014 mbar
Frequency Range	30 MHz to 18 GHz						
Perf. Criteria	Class B			**Perf. Verification**	Readings Under Limit		
Mod. to EUT	None			**Test Performed By**	Donn Foster & Bernd Jungbluth		

4.1.2 Test Procedure

Radiated emissions tests were performed using the procedures of ANSI C63.4:2014:A 2017 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range according Class **B**

limits was investigated for radiated emissions.

4.1.2.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emissions test procedure. The frequency range of interest was divided into sub-ranges. For each sub-range peak emission data was continuously recorded and plotted while the turntable was rotated 360° steps and the measurement antenna was rotated in horizontal and vertical antenna polarization.

Preliminary emission profile testing was performed inside a semi-anechoic chamber. The EUT was placed on a non-conductive table 80 cm above the floor. The EUT was positioned as shown in the setup photographs. The measurement antenna was placed at a distance of 3m.

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4.1.2.2 Final Test

Final testing was performed on an NSA compliant test site.

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. Preliminary emissions within 10 dB of the limit were measured.

The final scans were performed on the worst EUT axis for three operating channels in the operating mode with the highest power.

4.1.2.3 Deviations

None.

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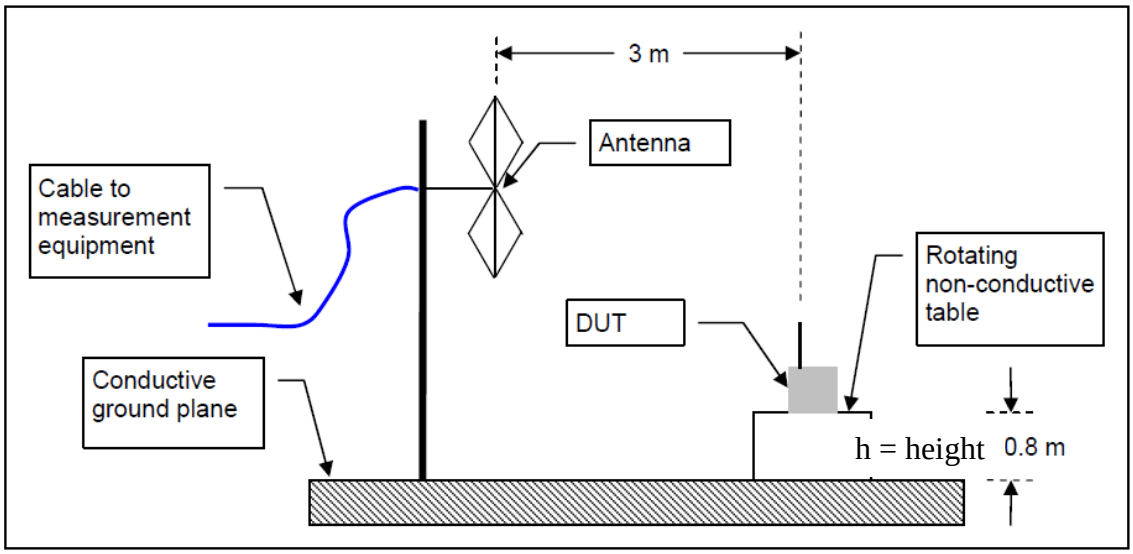
Test Setup:



h = 80cm

4.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the radiated emission test.

4.1.4 Final Test

All final radiated emissions measurements were below the specification limits.

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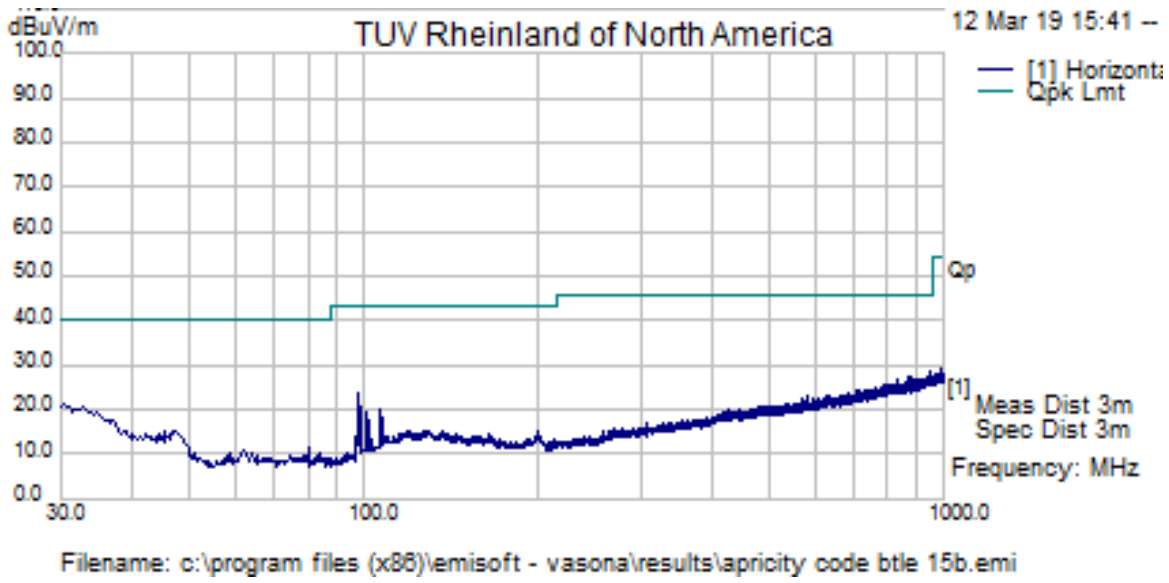
4.1.5 Plots

Radiated spurious emissions - FCC 15 B Unintentional emissions:

Radiated Emissions - 30MHz– 1 GHz – Rx – Idle mode			
EUT Name	Campfire BT Yoke	**Temp / Hum in**	21° C / 37%rh
EUT Model	4000	**Line AC / Freq**	N/A – Battery operated
EUT Config.	Rx – Idle mode	**RBW / VBW**	100KHz/ 300KHz
Standard	FCC 15 B	**Performed by**	Donald Foster
		Dist/Ant Used	3m/ JB3



Note: No Emissions identified via peak detector within 6dB of the limits. No final measurements executed.

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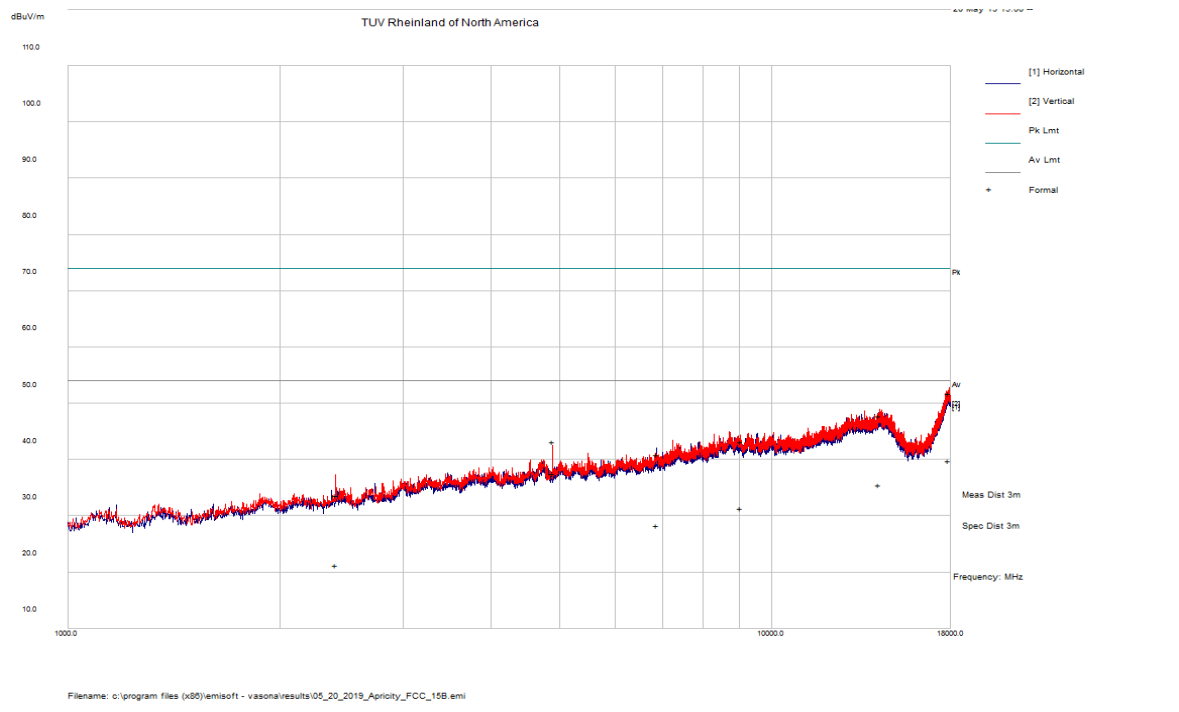
Radiated Emissions – 1GHz– 18 GHz – Rx – Idle mode			
EUT Name	Campfire BT Yoke	**Temp / Hum in**	21° C / 37%rh
EUT Model	4000	**Line AC / Freq**	N/A – Battery operated
EUT Config.	Rx – Idle mode	**RBW / VBW**	1 MHz/ 3 MHz
Standard	FCC 15 B	**Performed by**	Bernd Jungbluth
		Dist/Ant Used	3m – AHA-840

Frequency	Level	Detector	Polarity	Height	Azimuth	Limit	Margin	Result
MHz	dBuV/m		H/V	cm	deg	dBuV/m	dB	
6876.93	40.90	Peak Max	H	324	146	74.00	-33.10	Pass
6876.93	28.28	Average Max	H	324	146	54.00	-25.72	Pass
2402.73	33.73	Peak Max	V	227	92	74.00	-40.27	Pass
2402.73	21.27	Average Max	V	227	92	54.00	-32.73	Pass
4886.12	43.11	Peak Max	V	109	10	74.00	-30.89	Pass
4886.12	37.56	Average Max	V	109	10	54.00	-16.44	Pass
9036.34	43.15	Peak Max	V	120	30	74.00	-30.85	Pass
9036.34	31.32	Average Max	V	120	30	54.00	-22.68	Pass
14253.02	47.74	Peak Max	V	194	360	74.00	-26.26	Pass
14253.02	35.47	Average Max	V	194	360	54.00	-18.53	Pass
17904.49	52.72	Peak Max	V	285	356	74.00	-21.28	Pass
17904.49	39.76	Average Max	V	285	356	54.00	-14.24	Pass



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4.1.6 Photos

Figure 4 - Radiated Emissions Test Setup 30 - 1000 MHz - Front

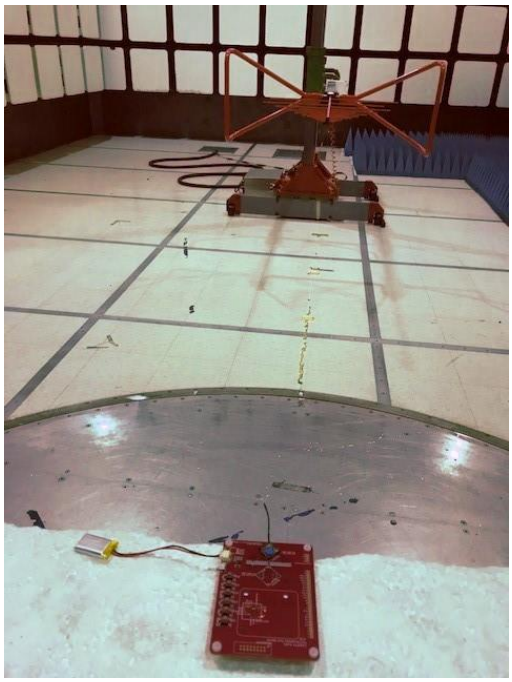

Figure 5 - Radiated Emissions 30MHz – 1 GHz rear

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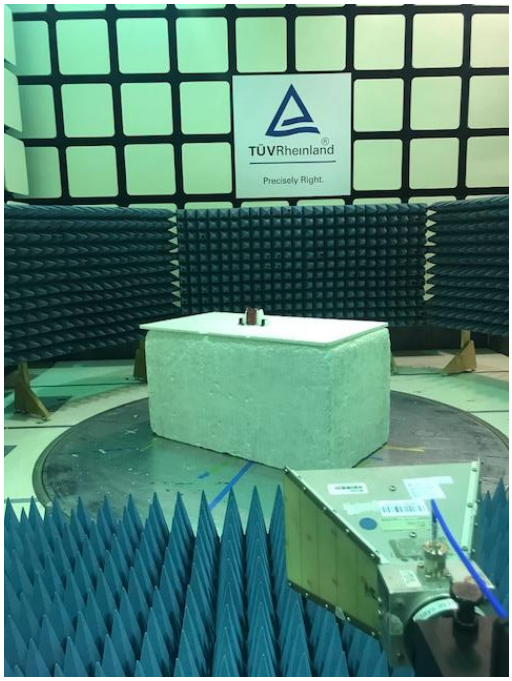

Figure 6 - Radiated Emissions 1-18 GHz front

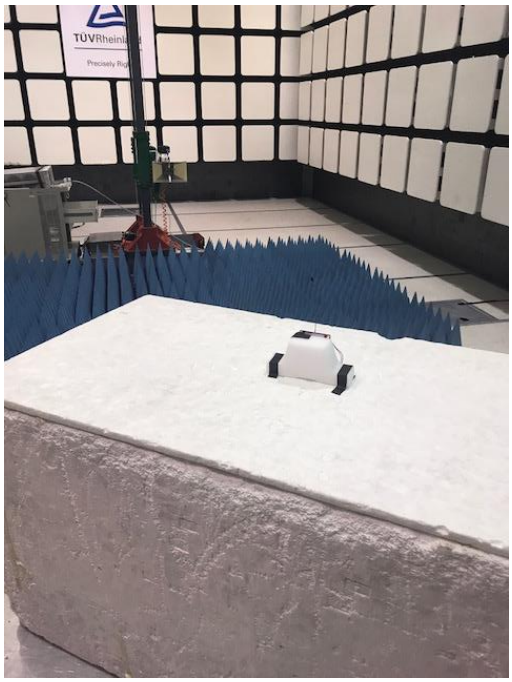

Figure 7 - Radiated Emissions 1 to 18GHz rear

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Appendix A

5 Test Plan

This test report is intended to follow this test plan outlined here in unless otherwise stated in this here report. The following test plan will give details on product information, standards to be used, test set ups and refer to TUV test procedures. The test procedures will give the steps to be taken when performing the stated test. The product information below came via client, product manual, product itself and or the internet.

5.1 General Information

Client	Apricity Code
Address	1001 SW Emkay Dr Ste 100
	Bend, OR 97702
Contact Person	Caitlin Metzger
Telephone	+1 541 204 4424
e-mail	caitlin@apricitycode.com

5.2 EUT Designation

Model Name	Campfire BT Yoke
Model Number(s)	4000

5.3 Test configurations

The Module is tested in active mode under continuous Rx\Idle mode configuration.

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5.3.1 Equipment Under Test (EUT) Description

The Campfire BT Yoke Model nr. 4000 is a BT Module. The Module was mounted in a development board to allow the configuration of a representative operational mode.

Table 5: EUT Specifications

EUT Specifications	
Dimensions	1.5cm x 1.5cm x 2 mm
DC Input	3.7 VDC, 15 mA (Battery operated)
Environment	Indoor/Outdoor
Multiple Feeds:	☐ Yes and how many ☒ No
Product Marketing Name (PMN)	Campfire BT Yoke
Modle Number	4000
Bluetooth Radio	
Operating Mode	BLE
Transmitter Frequency Band	2402 MHz to 2480 MHz
Operating Bandwidth	1 MHz
Max. Power Output	-0.98 dBm
Power Setting @ Operating Channel	0 dBm
Antenna Type	Whip antenna
Antenna Gain	3 dBi
Modulation Type	GFSK
Data Rate	1 Mbps

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Table 6: Antenna Information

Number	Antenna Type	Description	Max Gain (dBi)
Antenna 1	Whip Antenna	Max. peak gain at 2.4 GHz	3

Table 7: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
USB	USB	☐ No	3m	☒ M
Note: USB cable only used for operational configuration via the support PCB. USB cable removed from auxiliary PCB during testing.				

Table 1: Support Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Lenovo	T480 Thinkpad	N/A	Setup EUT operating channels with Bluestest 3 Software via USB connection to the auxiliary bench test\breakout board.
Host PCB Board	N/A	Campfire Audio Full Assembly Test Board V3.0	Host device for EUT - Module	Host PCB Board
Note: None.				

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Table 10: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup (X-Axis)	Setup (Y-Axis)	Setup (Z-Axis)
Campfire BT Yoke	Attached	Rx\Idle	See Block Diag	See Block Diag	N/A
Note:					

5.3.2 Block Diagram

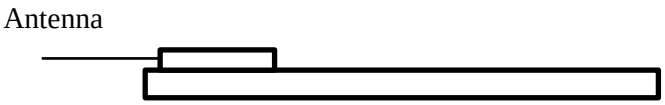

Figure 9 – Horizontal orientation

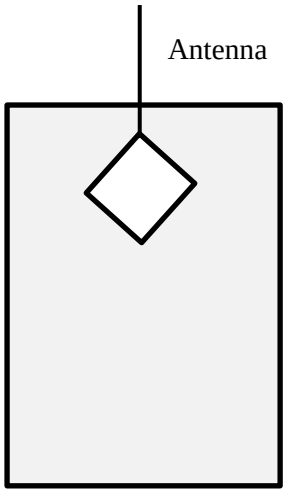

Figure 8 – Vertical Orientation

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5.4 Emissions

5.4.1 Radiated Emissions

5.4.1.1 Preliminary Radiated Emissions Test Setup

Standard	EN 55032:2012, CISPR 32:2015, CFR47 part 15B			**Procedure**	EN 55032:2012 ANSI C63.4: 2017
Limit	Class B	**Emissions Verification**		Emissions Under Limit	
Frequency Range	30 MHz – 18 GHz				
Scan #1	Pre-scan 30 – 1000 MHz	**Antenna Distance**	3m	**Detector**	Peak
Scan #2	Pre-scan 1 – 18 GHz	**Antenna Distance**	3m	**Detector**	Peak
Antenna Height	1 – 4 meter	**EUT height**	80 cm		
Configuration	See Section 5.3				
Notes	None				

5.4.1.2 Final Radiated Emissions Test Setup

Standard	EN 55032:2012/AC:2013, CISPR 32:2015, CFR47 part 15B			**Procedure**	EN 55032:2012/AC:2013ANSI C63.4: 2017
Limit	A	**Emissions Verification**		Emissions Under Limit	
Frequency Range	Class B				
Scan #1	Final Scan 30 – 1000 MHz	**Antenna Distance**	3m	**Detector**	Quasi Peak
Scan #2	Final Scan 1 – 18 GHz	**Antenna Distance**	3m	**Detector**	Average
Antenna Height	1 – 4 meter	**EUT height**	80 cm		
Configuration	See Section 5.3				
Notes	None				

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END OF REPORT

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