

Company: Shoof Technologies, Inc.

Test of: Strix Wireless Tag

To: FCC CFR 47 Pt 15.240 & ISED RSS-210 Annex D

Report No.: SHOO03-U7 Rev A

COMPLETE TEST REPORT





Test of: Shoof Technologies, Inc. Strix Wireless Tag

To: FCC CFR 47 Pt 15.240 & ISED RSS-210 Annex D

Test Report Serial No.: SHOO03-U7 Rev A

This report supersedes: NONE

Applicant: Shoof Technologies, Inc.
440 N. Wolfe Rd, Suite E112
Sunnyvale, California 94085
USA

Product Function; Wireless Tag

Issue Date; 14th February 2019

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
575 Boulder Court
Pleasanton California 94566
USA
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www.micomlabs.com



MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 3 of 38

Table of Contents

1. ACCREDITATION, LISTINGS & RECOGNITION.....	4
1.1. TESTING ACCREDITATION.....	4
1.2. RECOGNITION	5
1.3. PRODUCT CERTIFICATION	6
2. DOCUMENT HISTORY	7
3. TEST RESULT CERTIFICATE.....	8
4. REFERENCES AND MEASUREMENT UNCERTAINTY	9
4.1. Normative References	9
4.2. Test and Uncertainty Procedure	10
5. PRODUCT DETAILS AND TEST CONFIGURATIONS.....	11
5.1. Technical Details	11
5.2. Scope Of Test Program	12
5.3. Equipment Model(s) and Serial Number(s)	13
5.4. Antenna Details	13
5.5. Cabling and I/O Ports	13
5.6. Test Configurations.....	14
5.7. Equipment Modifications	14
5.8. Deviations from the Test Standard	14
6. TEST SUMMARY	15
7. TEST EQUIPMENT CONFIGURATION(S)	16
7.1. Radiated Emissions - 3m Chamber.....	16
8. MEASUREMENT AND PRESENTATION OF TEST DATA	19
9. TEST RESULTS	20
9.1.1. Radiated Emissions	20
9.1.1.1. TX Spurious & Restricted Band Emissions	20
15.240 Operation in the band 433.5-434.5 MHz.	22
9.1.2. Digital Emissions.....	25
9.1.3. Occupied Bandwidth	29
9.1.4. Automatically limiting operation;- Manufacturers declaration	31
A. APPENDIX - GRAPHICAL IMAGES	32
A.1.1. Radiated Emissions.....	33
A.1.1.1. TX Spurious & Restricted Band Emissions.....	33
A.1.2. Digital Emissions	35
A.1.3. Occupied Bandwidth.....	37

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1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



Accredited Laboratory

A2LA has accredited

MiCOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 14th day of May 2018.



President and CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2019

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.



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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 5 of 38

1.2. RECOGNITION

MiCOM Labs, Inc has widely recognized wireless testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA countries. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2 4143A-3
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

EU MRA – European Union Mutual Recognition Agreement.

NB – Notified Body

APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement. Recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase I - recognition for product testing

Phase II – recognition for both product testing and certification

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1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-02.pdf>



Accredited Product Certification Body

A2LA has accredited

MiCOM LABS

Pleasanton, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This product certification body also meets the A2LA R322 – *Specific Requirements – Notified Body Accreditation Requirements* and A2LA R308 - *Specific Requirements - ISO-IEC 17065 - Telecommunication Certification Body Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 14th day of May 2018




President and CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2019

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body (TCB)

Industry Canada – Certification Body, CAB Identifier – US0159

Europe – Notified Body (NB), NB Identifier - 2280

Japan – Recognized Certification Body (RCB), RCB Identifier - 210

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 7 of 38

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	11th January 2019	Draft report for client review.
Rev A	14th February 2019	Initial release.
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In the above table the latest report revision will replace all earlier versions.

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 8 of 38

3. TEST RESULT CERTIFICATE

Manufacturer: Shoof Technologies, Inc. 440 N. Wolfe Rd, Suite E112 Sunnyvale California 94085 USA	Tested By: MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model: Strix Wireless Tag	Telephone: +1 925 462 0304
Type Of Equipment: Wireless Tag	Fax: +1 925 462 0306
S/N's: FCC#1, FCC#2	
Test Date(s): 12 - 21 December 2018	Website: www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D	EQUIPMENT COMPLIES

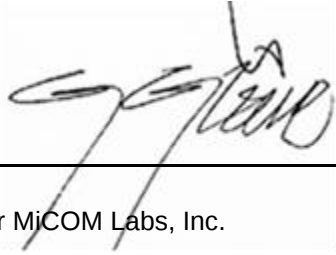
MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

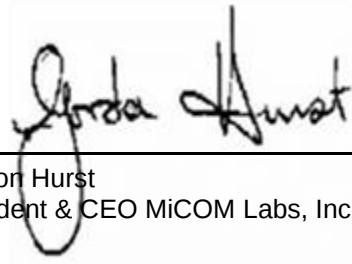
1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:





Graeme Grieve
Quality Manager MiCOM Labs, Inc.



Gordon Hurst
President & CEO MiCOM Labs, Inc.

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 9 of 38

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	FCC 47 CFR Part 15.240	2018	§15.240 Operation in the band 433.5-434.5 MHz
II	RSS-210 Issue 9	August 2016	Licence-Exempt Radio Apparatus: Category I Equipment
III	RSS-Gen Issue 5	April 2018	General Requirements for Compliance of Radio Apparatus
IV	ICES-003	Issue 6 Jan 2016; Updated April 2017	Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement.
V	A2LA	August 2018	R105 - Requirement's When Making Reference to A2LA Accreditation Status
VI	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
VII	ANSI C63.4	2014	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
VIII	ETSI TR 100 028	2001-12	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
IX	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
X	FCC 47 CFR Part 2.1033	2016	FCC requirements and rules regarding photographs and test setup diagrams.

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 10 of 38

4.2. Test and Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 11 of 38

5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

Details	Description
Purpose:	Test of the Shoof Technologies, Inc. Strix Wireless Tag to FCC CFR 47 Subpart C – Intentional Radiators Pt 15.240 & ISSED RSS-210 Annex D.
Applicant:	Shoof Technologies, Inc. 440 N. Wolfe Rd, Suite E112 Sunnyvale California 94085 USA
Manufacturer:	Shoof Technologies, Inc.
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	SHOO03-U7 Rev A
Date EUT received:	12 December 2018
Standard(s) applied:	FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Dates of test (from - to):	12 - 21 December 2018
No of Units Tested:	1
Product Family Name:	STRIX 3
Model(s):	520-020
Location for use:	Indoor/Outdoor
Declared Frequency Range(s):	433.5 - 434.5 MHz;
Type of Modulation:	OFDM
EUT Modes of Operation:	434 MHz:
Tx Power:	91.0 dBuV/m Peak field strength @ 3m 79.5 dBuV/m Average field strength @ 3m
Transmit/Receive Operation:	Transceiver
Rated Input Voltage and Current:	DC 3.6V, 0.8 A
Operating Temperature Range:	-40 - +85 °C
Equipment Dimensions:	1.315 X 3.426 in
Weight:	23g
Hardware Rev:	500-015
Software Rev:	360-009

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5.2. Scope Of Test Program

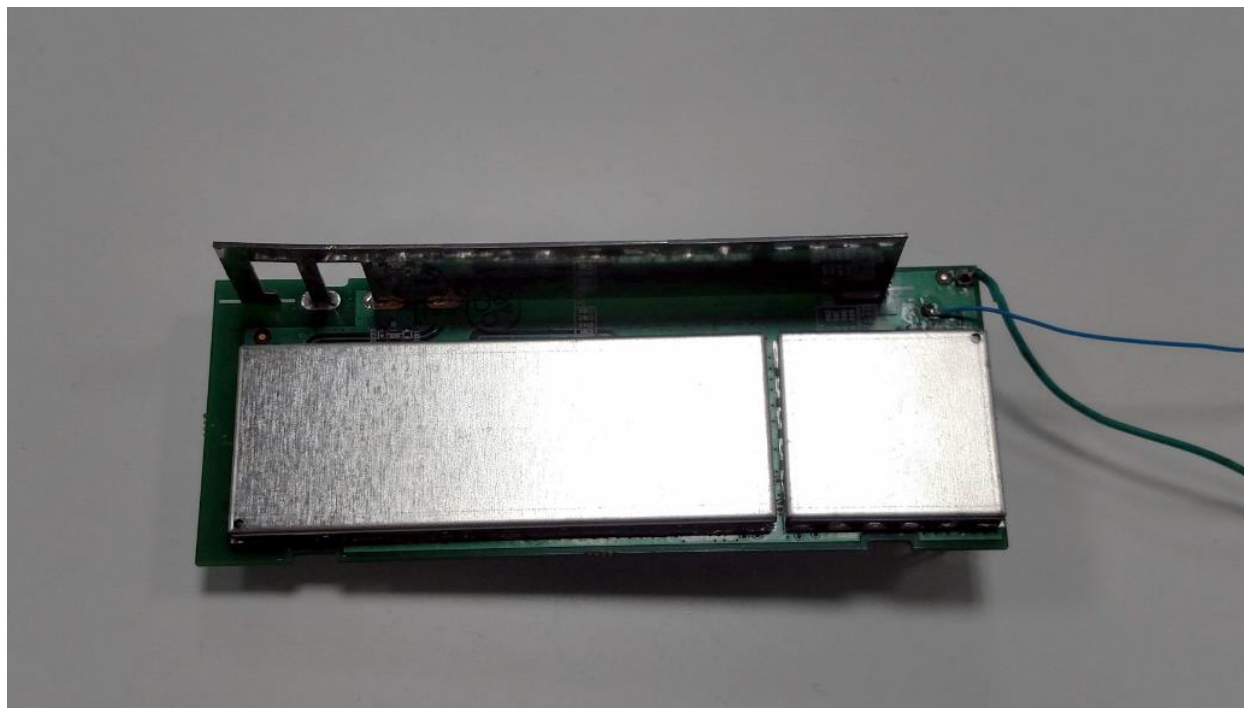
Shoof Technologies, Inc. Strix

The scope of the test program was to test the Shoof Technologies, Inc. Strix Wireless Tag, Strix configurations in the frequency ranges 433.5 - 434.5 MHz; for compliance against the following specification:

FCC CFR 47 Part 15 Radio Frequency Devices; Subpart C – Intentional Radiators
§15.240 Operation in the band 433.5-434.5 MHz

ISED RSS-210 Licence-Exempt Radio Apparatus: Category I Equipment
Annex D Radio Frequency Identification (RFID) Devices in the Band 433.5-434.5 MHz

Shoof Technologies, Inc. Strix Wireless Tag



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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 13 of 38

5.3. Equipment Model(s) and Serial Number(s)

Type	Description	Manf	Model	Serial No.
EUT	Wireless Inventory Tracking	Shoof Technologies	Strix Wireless Tag	FCC#1, FCC#2
Support	Laptop	Dell		
Support	DC Linear PS	HP	6274	

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
integral	Shoof		PCB	-5.0	-	360	-	433.5 - 434.5

BF Gain - Beamforming Gain
Dir BW - Directional BeamWidth
X-Pol - Cross Polarization

5.5. Cabling and I/O Ports

USB to TTL cable

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 14 of 38

5.6. Test Configurations

Results for the following configurations are provided in this report:

Results for the following configurations are provided in this report:				
Operational Mode(s))	Data Rate with Highest Power KBit/s	Channel Frequency (MHz)		
		Low	Mid	High
433.5 - 434.5 MHz				
FSK	50		434.0	

5.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

5.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 15 of 38

6. TEST SUMMARY

List of Measurements

Test Header	Result	Data Link
Emissions	Complies	-
Radiated Emissions	Complies	-
TX Spurious & Restricted Band Emissions	Complies	View Data
Digital Emissions	Complies	View Data
Occupied Bandwidth	Complies	View Data
On time Limitation for Transmission	Manufacturers Declaration	View Data

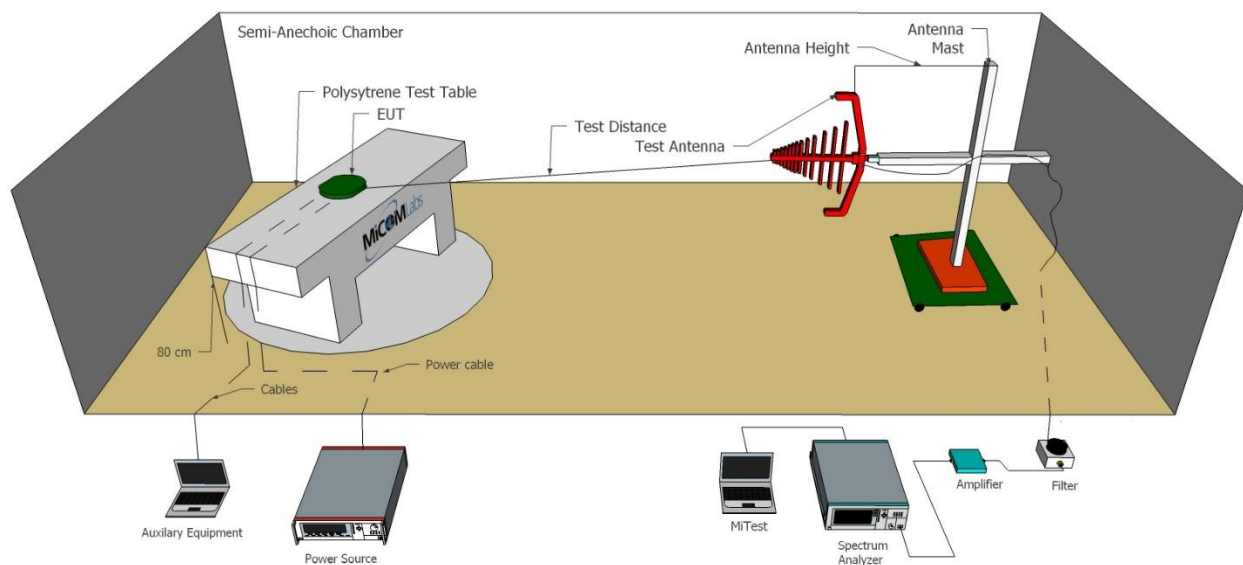
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7. TEST EQUIPMENT CONFIGURATION(S)

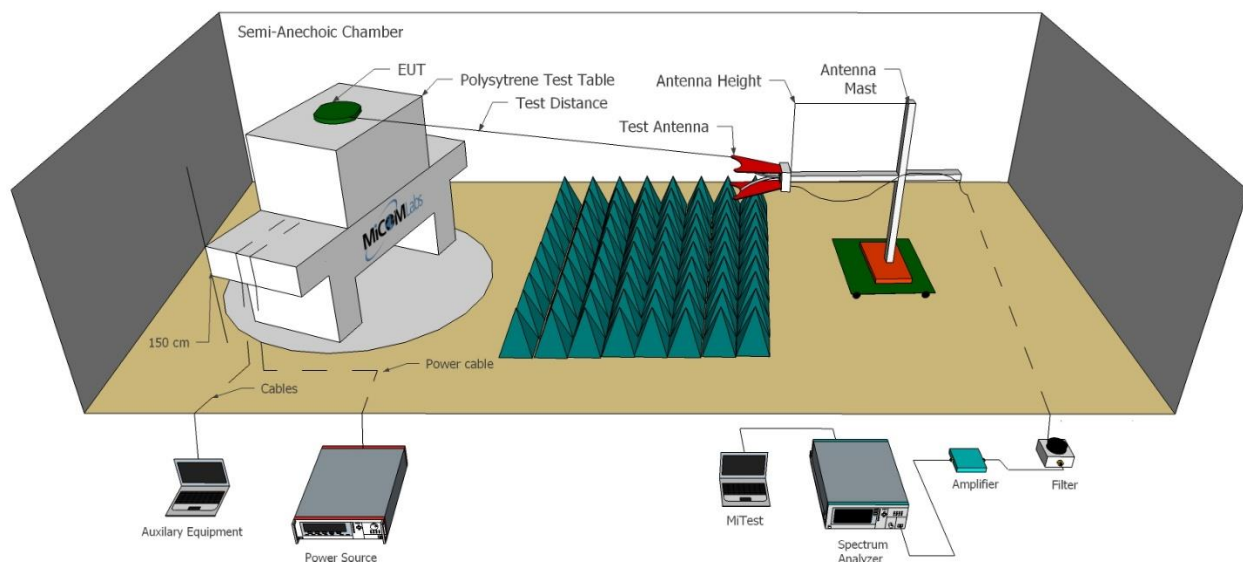
7.1. Radiated Emissions - 3m Chamber

The following tests were performed using the radiated test set-up shown in the diagrams below;- Radiated emissions below 1GHz; and Radiated Emissions above 1GHz.

Radiated Emissions Below 1GHz Test Setup



Radiated Emissions Above 1GHz Test Setup



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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 17 of 38

A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
298	3M Radiated Emissions Chamber Maintenance Check	MiCOM	3M Chamber	298	21 Jan 2019
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	4 Apr 2019
373	26III RMS Multimeter	Fluke	Fluke 26 series III	76080720	21 Sep 2019
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2019
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	12 Jan 2019
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	12 Oct 2019
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	12 Jan 2019
410	Desktop Computer	Dell	Inspiron 620	WS38	Not Required
411	Mast/Turntable Controller	Sunol Sciences	SC98V	060199-1D	Not Required
412	USB to GPIB Interface	National Instruments	GPIB-USB HS	11B8DC2	Not Required
413	Mast Controller	Sunol Science	TWR95-4	030801-3	Not Required
414	DC Power Supply 0-60V	HP	6274	1029A01285	Cal when used
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
447	MiTest Rad Emissions Test Software	MiCOM	Rad Emissions Test Software Version 1.0	447	Not Required
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	9 Oct 2019
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	9 Oct 2019
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	9 Oct 2019
466	Low Pass Filter DC-1500 MHz	Mini-Circuits	NLP-1750+	VUU10401438	9 Oct 2019
470	700 MHz High Pass Filter	Mini Circuits	SHP-700	None	9 Oct 2019
480	Cable - Bulkhead to	SRC Haverhill	157-3050360	480	24 Aug 2019

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 18 of 38

	Amp				
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	24 Aug 2019
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2019
518	Cable - Amp to Antenna	SRC Haverhill	157-3051574	518	24 Aug 2019
87	Uninterruptible Power Supply	Falcon Electric	ED2000-1/2LC	F3471 02/01	Cal when used
VLF-1700	Low pass filter DC-1700 MHz	Mini Circuits	VLF-1700	None	8 Oct 2019

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8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by [MiTest](#). [MiTest](#) is an automated test system developed by MiCOM Labs. [MiTest](#) is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.



The MiCOM Labs "[MiTest](#)" Automated Test System" (Patent Pending)

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9. TEST RESULTS

9.1.1. Radiated Emissions

9.1.1.1. TX Spurious & Restricted Band Emissions

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions (Restricted Bands)			
Standard:	FCC CFR 47 Part 15 Subpart C 15.240 & ISSED RSS-210 Annex D.	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	Radiated Spurious and Band-Edge Emissions	Rel. Humidity (%):	32 - 45
Standard Section(s):	15.205, 15.209, 15.240 (b) ISSED RSS-210 Annex D.	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Spurious and Band-Edge Emissions (Restricted Bands)

Radiated emissions for restricted bands above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned. Measurements on any restricted band frequency or frequencies above 1 GHz are based on the use of measurement instrumentation employing peak and average detectors. All measurements were performed using a resolution bandwidth of 1 MHz.

Test configuration and setup for Radiated Spurious and Band-Edge Measurement were per the Radiated Test Set-up specified in this document.

Limits for [Restricted Bands](#)

Peak emission: 74 dBuV/m

Average emission: 54 dBuV/m

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where:

FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss

Example:

Given receiver input reading of 51.5 dBmV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength (FS) of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dBmV/m}$$

Conversion between dBmV/m (or dBmV) and mV/m (or mV) are as follows:

$$\text{Level (dBmV/m)} = 20 * \text{Log (level (mV/m))}$$

$$40 \text{ dBmV/m} = 100 \text{ mV/m}$$

$$48 \text{ dBmV/m} = 250 \text{ mV/m}$$



Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 21 of 38

Restricted Bands of Operation (15.205)

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

Frequency Band			
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

(d) The following devices are exempt from the requirements of this section:

(1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a) of this section, the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a) of this section, and the fundamental emission is outside of the bands listed in paragraph (a) of this section more than 99% of the time the device is actively transmitting, without compensation for duty cycle.

(2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.

(3) Cable locating equipment operated pursuant to §15.213.

(4) Any equipment operated under the provisions of §15.253, 15.255, and 15.256 in the frequency band 75-85 GHz, or §15.257 of this part.

(5) Biomedical telemetry devices operating under the provisions of §15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 22 of 38

(6) Transmitters operating under the provisions of subparts D or F of this part.

(7) Devices operated pursuant to §15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.

(8) Devices operated in the 24.075-24.175 GHz band under §15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only, and shall not exceed the limits specified in §15.245(b).

(9) Devices operated in the 24.0-24.25 GHz band under §15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in §15.249(a).

(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of §15.245 shall not exceed the limits specified in §15.245(b).

15.240 Operation in the band 433.5-434.5 MHz.

(b) Limits

The field strength of any emissions radiated within the specified frequency band shall not exceed 11,000 microvolts per meter measured at a distance of 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The peak level of any emissions within the specified frequency band shall not exceed 55,000 microvolts per meter measured at a distance of 3 meters.

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 23 of 38

Equipment Configuration for Radiated Digital Emissions

Antenna:	Integral	Variant:	434 MHz
Antenna Gain (dBi):	0.0	Modulation:	FSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	434.00	Data Rate:	50 Kbit/s
Power Setting:	Max	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBµV	Cable Loss dB	AF dB/m	Level dBµV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBµV/m	Margin dB	Pass /Fail
#1	434.00	97.13	5.28	-11.40	91.01	Peak	Horizontal	100	165	94.8	-3.8	Pass
#2	434.00	85.63	5.28	-11.40	79.51	Average	Horizontal	100	165	80.8	-1.3	Pass
#3	866.97	38.18	6.54	-5.30	39.42	MaxQP	Horizontal	100	186	46.0	-6.6	Pass

Test Notes: EUT powered by DC Linear PS. Peak and Average limits for Transmitter per 15.240 Standard.

Note: click the links in the above matrix to view the graphical image (plot).

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 24 of 38

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	Integral	Variant:	434 MHz
Antenna Gain (dBi):	0.0	Modulation:	FSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	434.00	Data Rate:	50 Kbit/s
Power Setting:	Default	Tested By:	JMH

Test Measurement Results

1000.00 - 6000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	1300.50	18.40	-1.31	29.18	46.27	Max Peak	Vertical	100	148	74.0	-27.7	Pass
#2	1300.50	14.29	-1.31	29.18	42.16	Max Avg	Vertical	100	148	54.0	-11.8	Pass

Test Notes: EUT powered by DC linear PS

Note: click the links in the above matrix to view the graphical image (plot).

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 25 of 38

9.1.2. Digital Emissions

Radiated Test Conditions for Radiated Digital Emissions (0.03 – 1 GHz)			
Standard:	FCC CFR 47:15.209 & RSS-Gen Issue 5	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	Digital Emissions	Rel. Humidity (%):	32 - 45
Standard Section(s):	FCC 15.209 RSS-Gen Issue 5	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Digital Emissions (0.03 – 1 GHz)

Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

Test configuration and setup for Radiated Spurious and Band-Edge Measurement were per the Radiated Test Set-up specified in this document.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength

R = Measured Receiver Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

For example:

Given a Receiver input reading of 51.5dBmV; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3\text{dBmV/m}$$

Conversion between dBmV/m (or dBmV) and mV/m (or mV) are done as:

$$\text{Level (dBmV/m)} = 20 * \text{Log (level (mV/m))}$$

$$40 \text{ dBmV/m} = 100\text{mV/m}$$

$$48 \text{ dBmV/m} = 250\text{mV/m}$$

Limits for Radiated Digital Emissions (0.03 – 1 GHz)

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:



Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 26 of 38

Frequency (MHz)	Field Strength		Measurement Distance (m)
	$\mu\text{V/m}$ (microvolts/meter)	$\text{dB}\mu\text{V/m}$ (dB microvolts/meter)	
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46.0	3
Above 960	500	54.0	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241. (b) In the emission table above, the tighter limit applies at the band edges. (c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency. (d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. (e) The provisions in §§15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part. (f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device. (g) Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 27 of 38

Equipment Configuration for Radiated Digital Emissions

Antenna:	Integral	Variant:	434 MHz
Antenna Gain (dBi):	0.00	Modulation:	FSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	Not Applicable
Channel Frequency (MHz):	Not Applicable	Data Rate:	Not Applicable
Power Setting:	Not Applicable	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
#1	466.19	34.19	5.42	-10.60	29.01	MaxQP	Horizontal	204	241	46.0	-17.0	Pass

Test Notes: EUT powered by DC Linear PS. RCVR

Note: click the links in the above matrix to view the graphical image (plot).

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 28 of 38

Equipment Configuration for Digital Emissions 1-10GHz			
--	--	--	--

Antenna:	Integral	Variant:	434 MHz
Antenna Gain (dBi):	0.00	Modulation:	FSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	Not Applicable
Channel Frequency (MHz):	Not Applicable	Data Rate:	Not Applicable
Power Setting:	Not Applicable	Tested By:	JMH

Test Measurement Results

Click here to view measurement data...
--

Test Notes: EUT powered by DC linear PS, RCVR

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 29 of 38

9.1.3. Occupied Bandwidth

Radiated Test Conditions for Radiated Digital Emissions (0.03 – 1 GHz)			
Standard:	RSS-Gen Issue 5	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	Occupied Bandwidth	Rel. Humidity (%):	32 - 45
Standard Section(s):	RSS-Gen Issue 5	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for 99% Bandwidth Measurement

The bandwidth at 99 % was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

Testing was performed under ambient conditions at nominal voltage.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 30 of 38

Equipment Configuration for Occupied Bandwidth

Variant:	433	Duty Cycle (%):	99
Data Rate:	Not Applicable	Antenna Gain (dBi):	0.00
Modulation:	FSK	Beam Forming Gain (Y)(dB):	Not Applica433
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

99% Bandwidth (kHz)	
Voltage	Channel Frequency: 433.875 MHz
3.7 Vdc	<u>241.48</u>

Laboratory Measurement Uncertainty for Spectrum Measurement

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 31 of 38

9.1.4. Automatically limiting operation;- Manufacturers declaration



Feb 13, 2019

Declaration for FCC and IC for the band 433.5MHZ – 434.5MHZ

The Strix radio is provided with a means for automatically limiting operation in compliance FCC 15.240(b) and IC RSS-210 Annex D(a) .The firmware is designed so that the duration of each transmission shall not be greater than 60 seconds and be only permitted to reinitiate an interrogation in the case of a transmission error. Absent such a transmission error, the silent period between transmissions shall is guaranteed not be less than 10 seconds.

Sincerely,
Elad Gottlieb, CDO, Shoof Technologies



Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 32 of 38

A. APPENDIX - GRAPHICAL IMAGES

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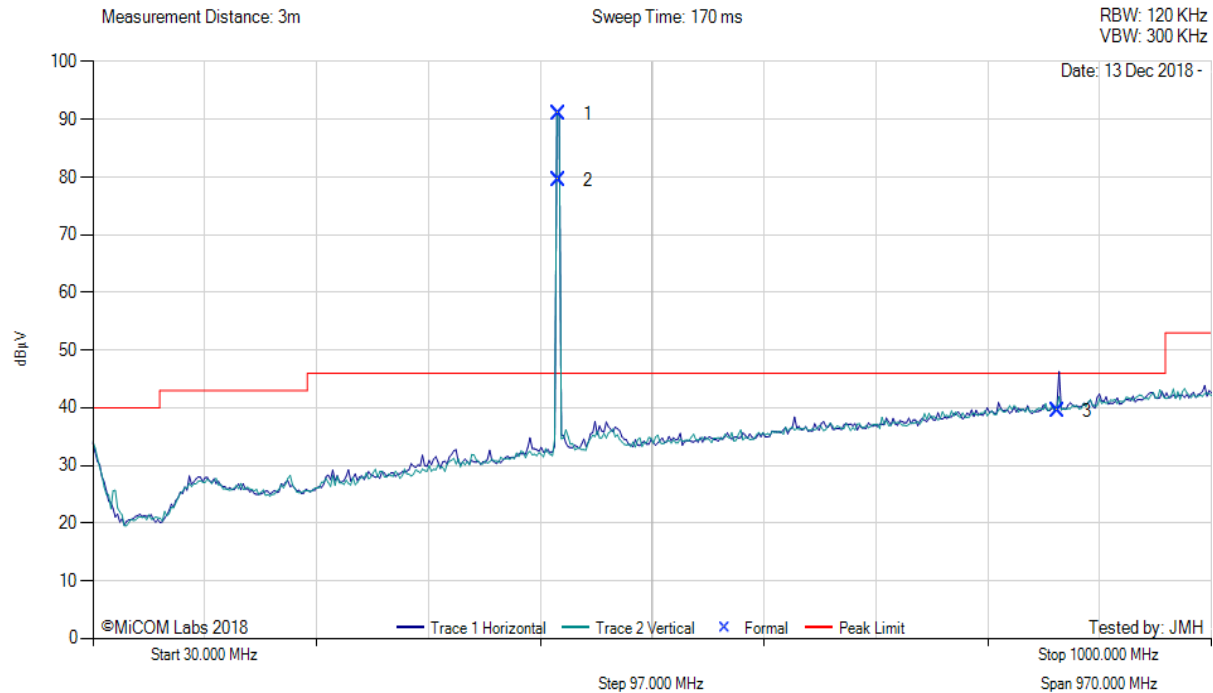
Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 33 of 38

A.1.1. Radiated Emissions

A.1.1.1. TX Spurious & Restricted Band Emissions



Variant: 434.00 MHz, Power Setting: Default, Duty Cycle (%): 99



30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	434.00	97.13	5.28	-11.40	91.01	Peak	Horizontal	100	165	94.8	-3.8	Pass
2	434.00	85.63	5.28	-11.40	79.51	Average	Horizontal	100	165	80.8	-1.3	Pass
3	866.97	38.18	6.54	-5.30	39.42	MaxQP	Horizontal	100	186	46.0	-6.6	Pass

Test Notes: EUT powered by DC Linear PS. Peak and Average limits for Transmitter per 15.240 Standard

[back to matrix](#)

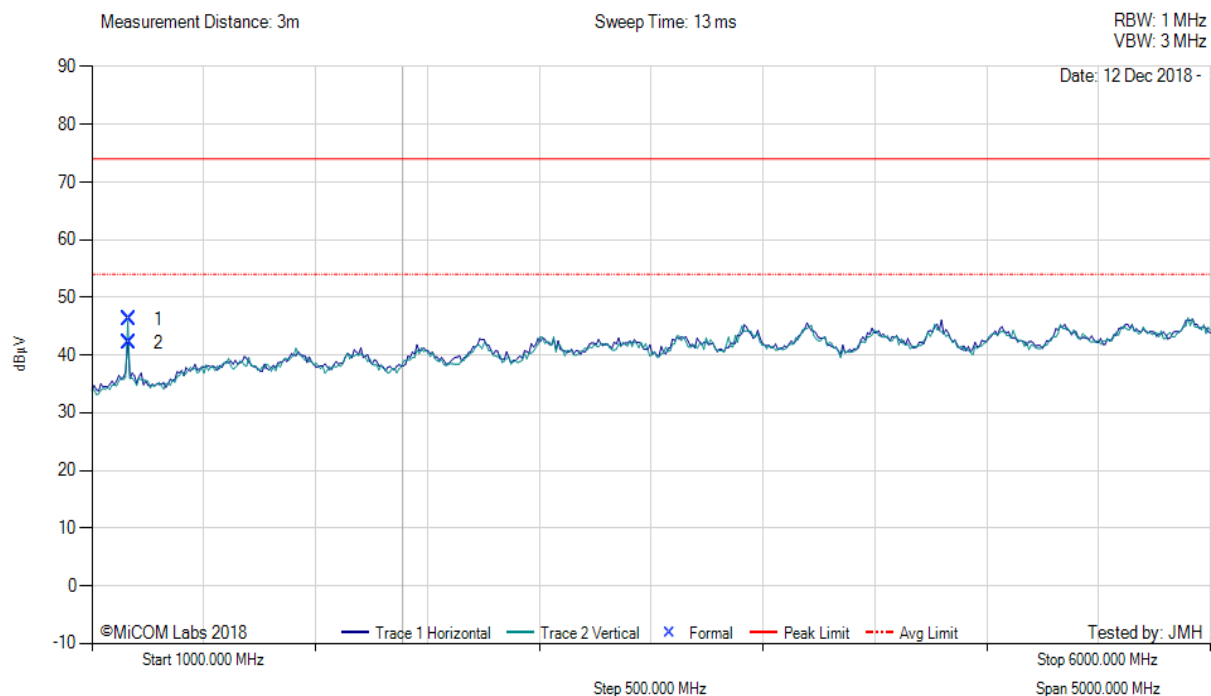
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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 34 of 38



Variant: 434.00 MHz, Power Setting: Default, Duty Cycle (%): 99



1000.00 - 6000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	1300.50	18.40	-1.31	29.18	46.27	Max Peak	Vertical	100	148	74.0	-27.7	Pass
2	1300.50	14.29	-1.31	29.18	42.16	Max Avg	Vertical	100	148	54.0	-11.8	Pass

Test Notes: EUT powered by DC linear PS

[back to matrix](#)

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Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 35 of 38

A.1.2. Digital Emissions



RADIATED DIGITAL EMISSIONS



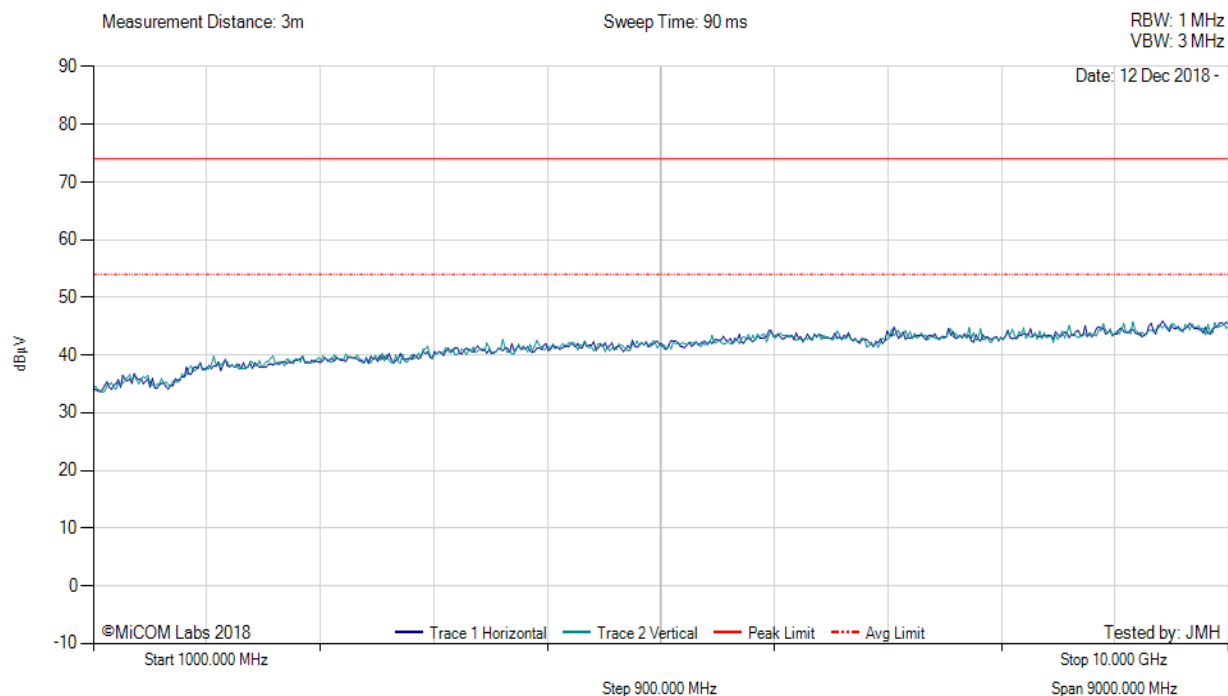
30.00 - 1000.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB/m	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	466.19	34.19	5.42	-10.60	29.01	MaxQP	Horizontal	204	241	46.0	-17.0	Pass

Test Notes: EUT powered by DC Linear PS. RCVR

[back to matrix](#)

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RADIATED DIGITAL EMISSIONS



There are no emissions found within 6dB of the limit line.

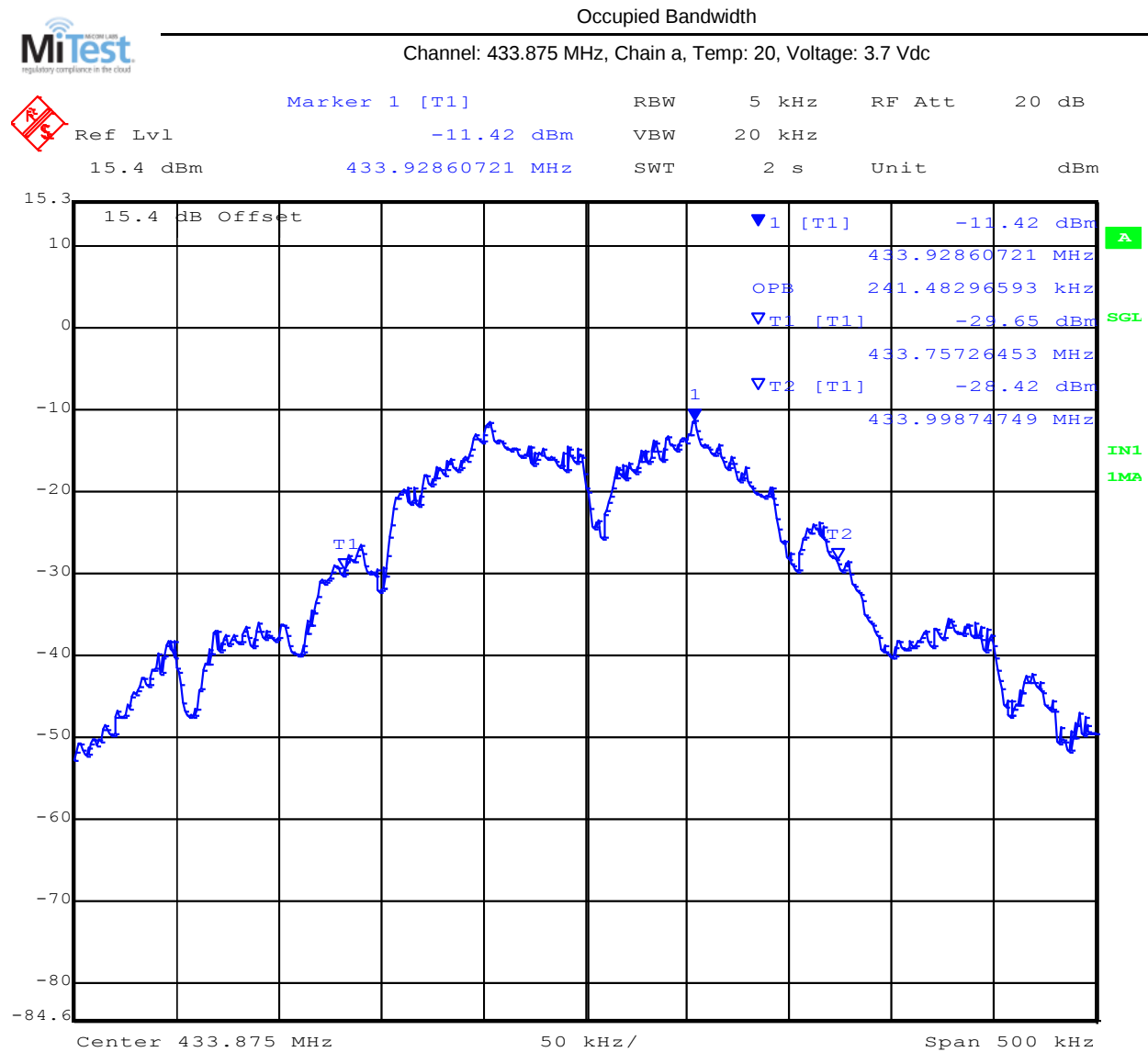
Test Notes: EUT powered by DC linear PS, RCVR

[back to matrix](#)



Title: Shoof Technologies, Inc. Strix Wireless Tag
To: FCC CFR 47 Pt 15.240 & ISSED RSS-210 Annex D
Serial #: SHOO03-U7 Rev A
Issue Date: 14th February 2019
Page: 37 of 38

A.1.3. Occupied Bandwidth



[back to matrix](#)

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