Electromagnetic Compatibility Test Report

Description: Biometrically-Secured Ring

Model: Token

Tokenize Inc.
4545 East River Road
West Henrietta, NY, 14586

Prepared by:

TUV Rheinland of North America, Inc.

The test results contained in this report refer exclusively to the product(s) presented for testing. No liability may be assumed for models or products not referred to herein. This test report may not be published or duplicated in part without permission of the testing body. This test report by itself does not constitute authorization for the use of any TUV Rheinland test mark. The report must not be used by the client to claim product certification, approval, or endorsement by A2LA.

Client:	Tokenize Inc. 4545 East River Road West Henrietta, NY, 14586	***Contact:*** ***Tel:*** ***Fax:*** ***e-mail:***	Richard Lourette 585-953-5309 -- richard@tokenring.com
Identification:	Biometrically-Secured Ring	***Serial No.:***	0001
Test item:	Token	***Date Test Completed:***	03/18/2020
Testing location:	TUV Rheinland of North America 710 Resende Road, Building 199 Webster, NY 14580 U.S.A.	Tel: (585) 645-0125 Fax: -	
Test specification:	**Emissions:** FCC CFR 47 §15.225		
Test Result and/or Conclusion:	The above product was found to be **Compliant** to the above test standard(s)		

Report written/updated by: Alexander Sowinski	***reviewed by:*** Rachana Khanduri
31 March 2020 ***Date*** ***Signature***	31 March 2020 ***Date*** ***Signature***

FCC	ilac-MRA ACCREDITED	VCCI	**Industry Canada ISED**
5253	**3331.08**	**1097 (A-0329)**	**482B-1**

Revisions

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1 General Information

1.1 Scope

This report is intended to document the status of conformance based on the results of testing performed on the Biometrically-Secured Ring, Model Number: Token, manufactured by Tokenize Inc.. 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.

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.

1.3 *Summary of Test Results*

Applicant:	Tokenize Inc. 4545 East River Road West Henrietta, NY, 14586	**Tel:**	585-953-5309	**Contact:**	Richard Lourette
		Fax:	--	**e-mail:**	richard@tokenring.com

Description:	Biometrically-Secured Ring	**Model Number:**	Token
Serial Number:	0001	**Test Voltage/Freq.:**	4 VDC
Test Date Completed:	03/18/2020	**Test Engineer:**	Alexander Sowinski

Standards	Description	Severity Level or Limit	Criteria	Test Result
FCC CFR 47 §15.225 Product Family Standard Emissions	Emission requirements for devices operating within the band 13.110 - 14.010 MHz	See Basic Standards Below	See Below	**Complies**
FCC CFR 47 §15.225 (a)	Carrier Field Strength	< 124 dBµV/m @ 3 meters	Limit	**Complies**
FCC CFR 47 §15.215 (c)	Occupied Bandwidth	Report values	N/A	**Complies**
FCC CFR 47 §15.225 (b, c)	Out of Band Emissions	Per Limit lines	Limit	**Complies**
FCC CFR 47 §15.225 (d); §15.209	Transmitter Spurious Emissions	Class B, 9kHz - 1000 MHz	Limit	**Complies**
FCC CFR 47 §15.205	Restricted Bands of Operation	Class B	Limit	**Complies**
FCC CFR 47 §15.225 (e)	Frequency Stability	100 ppm / ±0.01%	Limit	**Complies**
FCC CFR 47 §15.225 (e) Basic test standard	Voltage Variation	100 ppm / ±0.01%	Limit	**Complies**

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at, 710 Resende Road Webster, NY 14580 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 5253). The laboratory scope of accreditation includes: Title 47 CFR Part 15, and 18. The accreditation is updated every 3 years.

2.1.2 ILAC/A2LA

This is a program which is administered under the auspices of A2LA. The laboratory has been assessed and accredited in accordance with ISO Standard 17025:2017 (Certificate Number: 3331.08). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 VCCI

VCCI Accredited test lab. Registration numbers A-0329.

2.1.4 Industry Canada

(Registration No.: 482B-1) The 10 meter Semi-Anechoic chamber has been accepted by Industry Canada to perform testing to 3 and to 10m, based on the test procedures described in ANSI C63.4-2014.

2.1.5 BSMI

Registration No.: SL2-IN-E-1159R. The BSMI accreditation was obtained by NIST MRA with the BSMI.

2.1.6 Korea

(Designation No.: US0192). Recognized by National Radio Research Agency (RRA) as an accredited Conformity Assessment Body (CAB) under the terms for Korea Phase I of the APEC TEL.

2.2 Test Software

1) CIGUI 32 Version 1.4 for California Instruments AC power source
2) HP software E7415A Version A.01.45
3) National Instruments 'Measurement & Automation Employer' Version 4.6.2f1
4) TILE version 3.4.K.28
5) Voltech PM 6000 Firmware 1.22.07RC6, Software IEC61000-3 for PM6000 Release 1.24.12
6) California Instruments AC power source MXHCL
7) Rohde & Schwarz EMI Measurement software EMC32 version 8.50.0
8) TILE version 4.0.B
9) Keytek CEWare 2.10

2.3 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.

2.3.1 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

2.3.2 Measurement Uncertainty Emissions

Per CISPR 16-4-2	**Ulab**	**Ucispr**
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	4.57 dB	5.2 dB
Radiated Disturbance @ 3m		
1.0 GHz – 6.0 GHz	5.18 dB	5.2 dB
6.0 GHz – 18.0 GHz	5.48 dB	5.5 dB
18.0 GHz – 26.5 GHz	5.21 dB	
26.5 GHz – 40.0 GHz	4.99 dB	
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	2.62 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.88 dB	4.5 dB

Measurement Uncertainty Emissions

The estimated combined standard uncertainty for radiated emissions measurements is ± 4.57 dB	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for radiated emissions measurements from 1 GHz to 6 GHz is ± 5.18dB	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for radiated emissions measurements from 6 GHz to 18 GHz is ± 5.48dB	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for conducted emissions measurements is ± 2.62dB.	Per CISPR16-4-2 Method

Expanded measurement uncertainty numbers are shown in the tables above. Compliance criteria are not based on measurement uncertainty.

2.4 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 ISO IEC 17025:2017. Equipment calibration records are kept on file at the test facility.

2.5 Measurement Equipment Identification

Equipment	Manufacturer	Model #	Ref.	Serial #	Last Cal dd/mm/yy	Next Cal dd/mm/yy	Test
Radiated Emissions							
Receiver (20Hz-40GHz)	Rohde & Schwarz	ESU 40		100274	29-Jul-19	29-Jul-20	RE
BiLog	Sunol	JB3		A102115	27-Jun-18	27-Jun-20	RE
Amplifier	EMCO	6502		8901-2302	24-Apr-18	24-Apr-20	RE
Loop Antenna	EMCO	6502		8901-2302	24-Apr-18	24-Apr-20	RE
General Laboratory Equipment							
Multimeter	Fluke	87		59890224	1-Aug-19	1-Aug-20	
Pressure/Temperature/RH	Control Company	68000-49		181704893	31-Oct-18	31-Oct-20	

Note: RE = Radiated Emissions

3 Product Information

3.1 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.

3.2 EUT Photos

Due to the confidentiality agreement with the client, EUT photos are contained within the document 32051118.001

4 Emissions

4.1 Carrier Field Strength Requirements

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

4.1.1 Over View of Test

Results	**Complies** (as tested per this report)					**Date**	03/16/2020
Standard	FCC CFR 47 §15.225 (a)						
Product Model	Token			**Serial#**	0001		
Configuration	See test plan for details.						
Test Set-up	Tested 3 meters semi- anechoic chamber placed on turn-table, see test plans for details.						
EUT Powered By	4 VDC	**Temp**	24º C	**Humidity**	33%	**Pressure**	998mbar
Frequency Range	13.56 MHz						
Perf. Criteria	< 124 dBµV/m @ 3 meters			**Perf. Verification**	Readings Under Limit		
Mod. to EUT	None			**Test Performed By**	Alexander Sowinski		

4.1.2 Test Procedure

Carrier field strength tests were performed using the procedures of FCC CFR 47 §15.225 (a) and/or ANSI C63.10 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration. Further radiated emission tests were performed per the procedures stated in the other emissions standards listed in this report.

4.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the carrier field strength test.

4.1.4 Final Test

All final carrier field strength measurements were below (in compliance) the limits.

4.1.5 Final Data

Test Conditions: Radiated Measurement, Nominal Temperature and Voltage only						
Antenna Type: Integrated				**Power Setting: Maximum**		
Signal State: Modulated				**Duty Cycle:** 100%		
Operating Frequency	**Test Results**					
13.56 MHz	Measured Level [dBµV/m]	Loop Position	Table [deg]	Antenna [cm]	Limit [dBµV/m]	Margin [dB]
X-axis	30.51	0°	87	100.0	124.0	-93.49
	17.39	90°	137	100.0	124.0	-106.61
Y-axis	26.11	0°	110	100.0	124.0	-97.89
	22.21	90°	262	100.0	124.0	-101.79
Z-axis	32.37	0°	221	100.0	124.0	-91.63
	7.31	90°	27	100.0	124.0	-116.69
Note: Measurements taken at 3 meters, limits extrapolated accordingly.						

4.2 Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

4.2.1 Over View of Test

Results	**Complies** (as tested per this report)					**Date**	03/16/2020
Standard	FCC CFR 47 §15.215 (c)						
Product Model	Token			**Serial#**	0001		
Configuration	See test plan for details.						
Test Set-up	Tested at 3 meters semi-anechoic chamber, EUT placed on table. See test plans for details.						
EUT Powered By	4 VDC	**Temp**	24º C	**Humidity**	33%	**Pressure**	998mbar
Frequency Range	13.553 – 13.567 MHz						
Perf. Criteria	None	**Perf. Verification**	All markers within allowable band				
Mod. to EUT	None	**Test Performed By**	Alexander Sowinski				

4.2.2 Test Procedure

The radiated method was used to measure the occupied bandwidth according to ANSI C63.10:2009. The measurement was performed with modulation. The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied. The 6dB bandwidth is defined the bandwidth of 6 dBr from highest transmitted level of the fundamental frequency.

4.2.3 Deviations

There were no deviations from the test methodology listed in the test plan for the occupied bandwidth test.

4.2.4 Final Test

All final occupied bandwidth measurements were below (in compliance) the limits.

4.2.5 Final Data

Test Conditions: Radiated Measurement, Nominal Temperature and Voltage only				
Antenna Type: Integrated			**Power Setting: Maximum**	
Signal State: Modulated			**Duty Cycle:** 100%	
Occupied Bandwidth for 13.56 MHz NFC				
Orientation	Loop Position	Limit [kHz]	99% OBW [kHz]	6 dB OBW [kHz]
X-axis	0°	N/A	3.589744	0.737179
	90°	N/A	4.935897	0.905449
Y-axis	0°	N/A	4.246794	0.753205
	90°	N/A	4.214744	0.753205
Z-axis	0°	N/A	1.434295	0.729166
	90°	N/A	4.951923	1.27404
Note: 99% and 6dB OBW markers all observed to reside entirely with 13.553 – 13.567 MHz band.				

4.2.6 Sample Plots

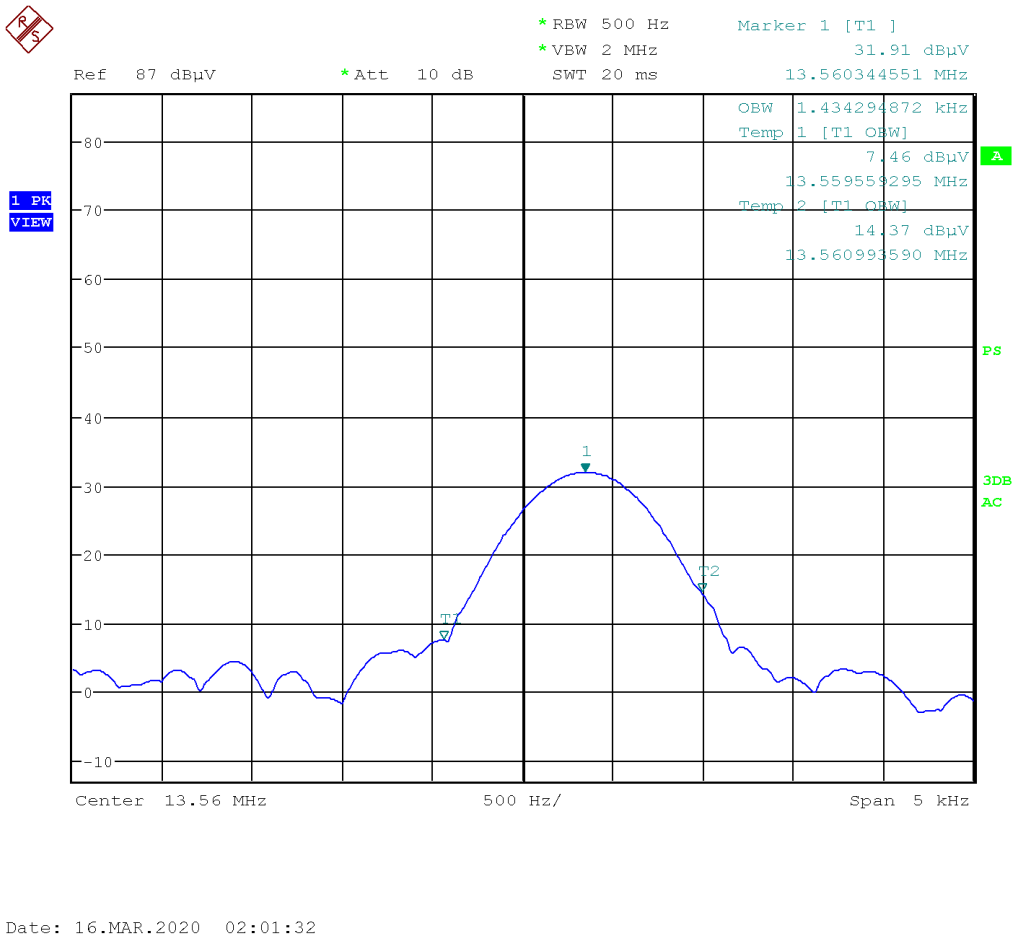


Figure 1 – Sample 99% OBW Plot (Z-axis, 0°)

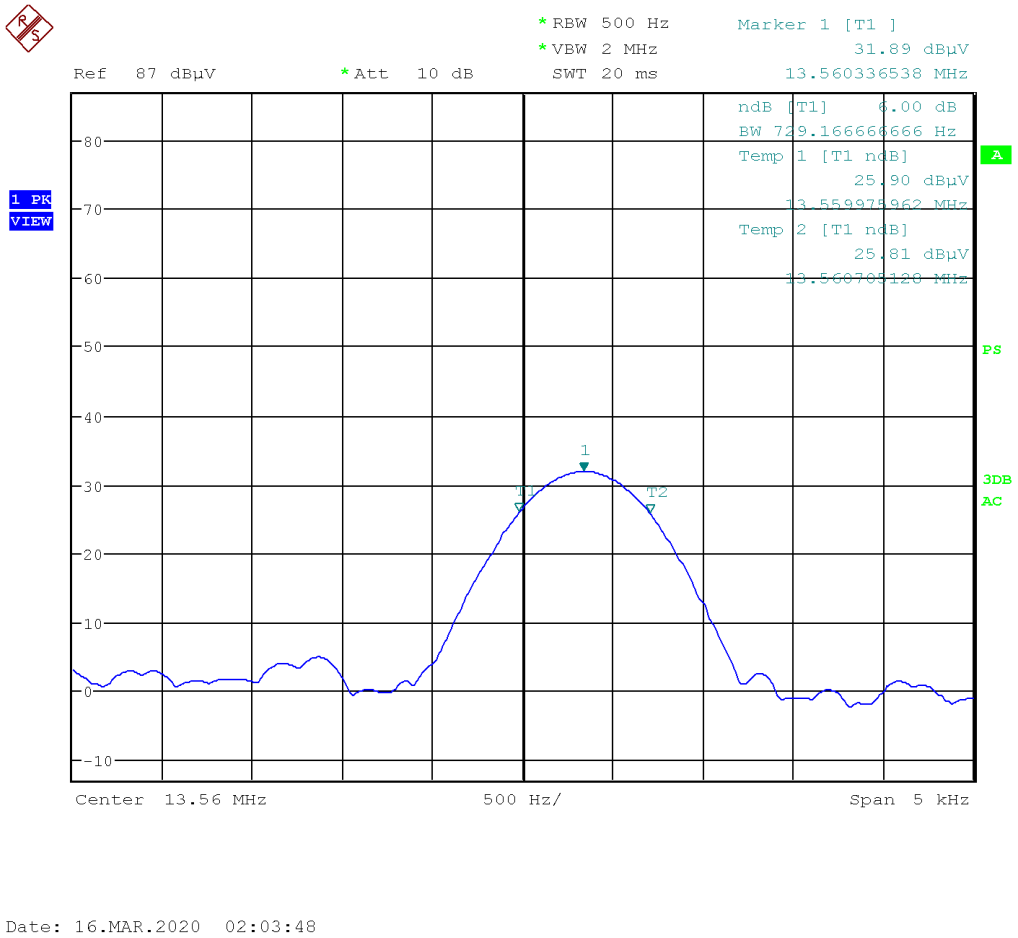


Figure 2 – Sample 6 dB OBW Plot (Z-axis, 0°)

4.3 Out of Band Emissions

The out of band emission is leakage measurement of the main carrier outside the allocated operating frequency band; 13.553 MHz to 13.567 MHz.

4.3.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	03/16/2020	
Standard	FCC CFR 47 §15.225 (b, c)						
Product Model	Token			**Serial#**	0001		
Configuration	See test plan for details.						
Test Set-up	Tested in shielded room, EUT placed on table. See test plan for details.						
EUT Powered By	4 VDC	**Temp**	24º C	**Humidity**	33%	**Pressure**	998 mbar
Perf. Criteria	See Appendix A (Below Limits			**Perf. Verification**	Readings under Limit		
Mod to EUT	None			**Test Performed By**	Alexander Sowinski		

4.3.2 Test Procedure

The radiated method was used to measure the out-of-band emission requirement. The measurement was performed with modulation per CFR 47 15.225 (b, c). The worst case (Z-axis) results are reported below. No spurious emissions detected in X or Y orientations.

4.3.3 Deviations

There were no deviations from the test methodology listed in the test plan for the out of band emissions test.

4.3.4 Final Test

The out of band emissions of the EUT were below the limits specified in the standard.

4.3.5 Final Data

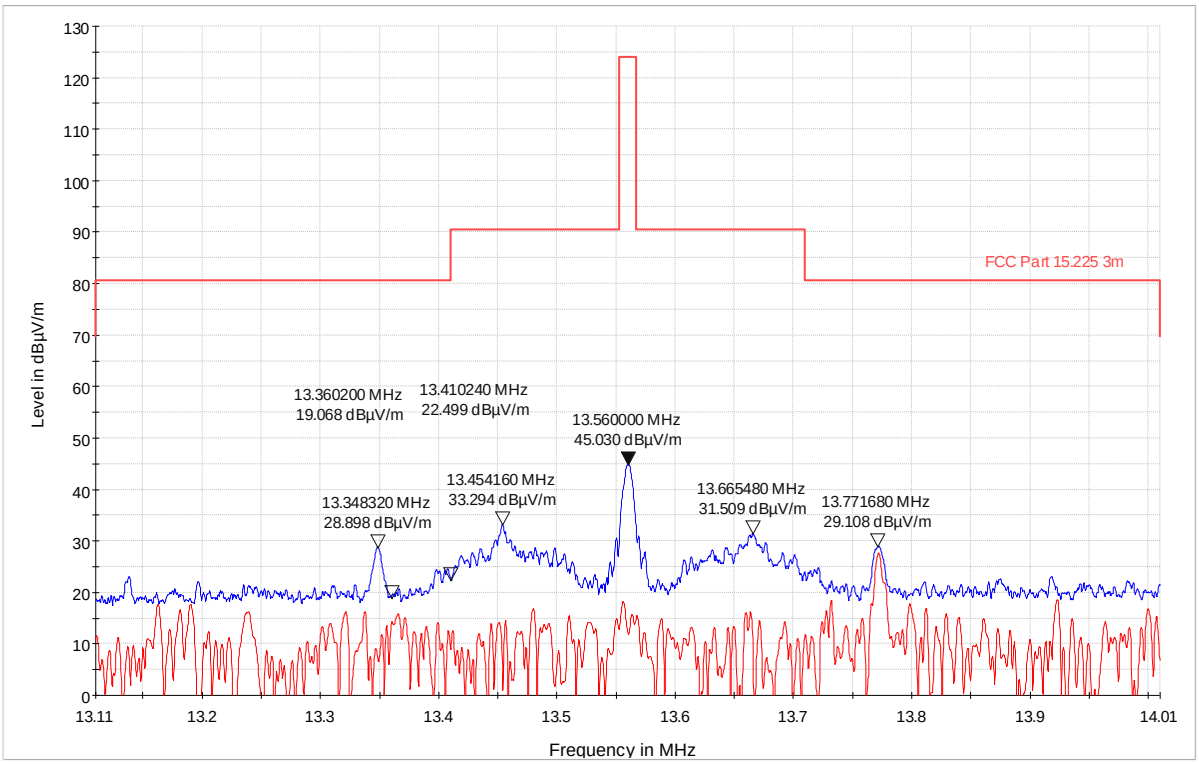


Figure 3 – Out of Band Emissions (Z-axis, 0°)

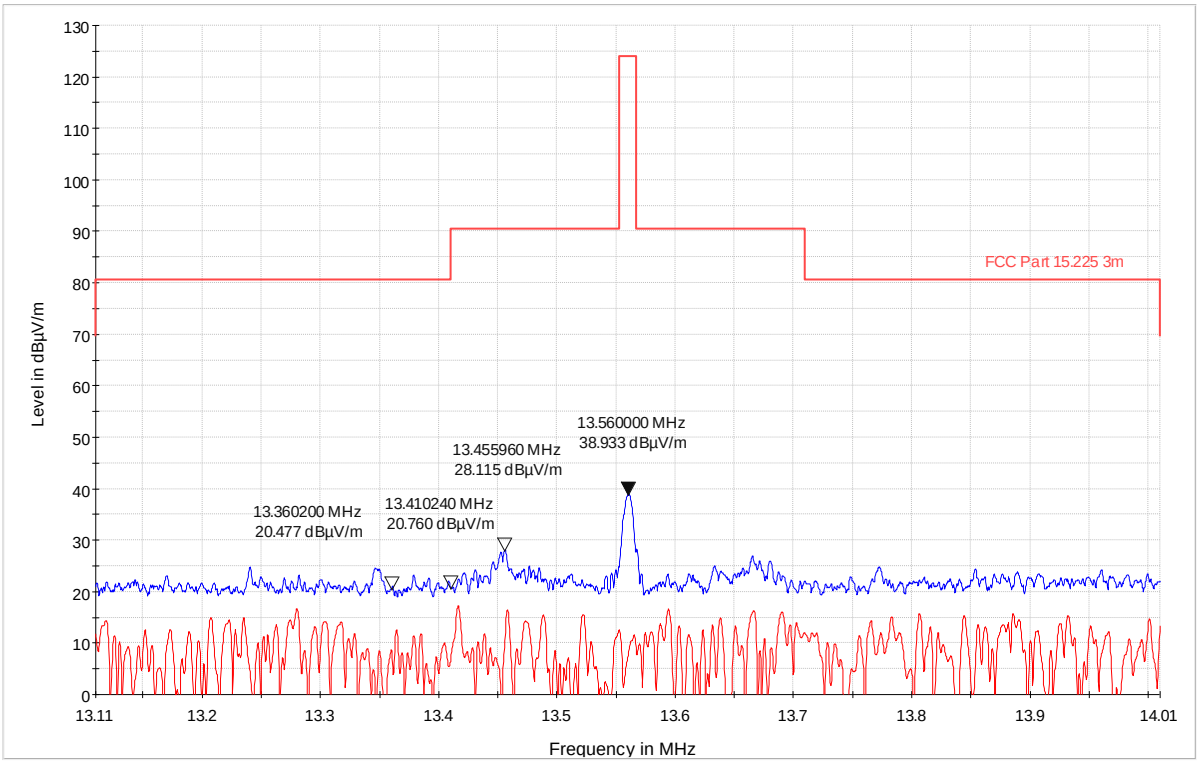


Figure 4 – Out of Band Emissions (Z-axis, 90°)

4.4 Transmitter Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.225(d).

4.4.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	03/16/2020
Standard	FCC CFR 47 §15.225 (d); §15.209						
Product Model	Token			**Serial#**	0001		
Configuration	See test plan for details.						
Test Set-up	Tested 3 meters semi- anechoic chamber placed on turn-table, see test plans for details.						
EUT Powered By	4 VDC	**Temp**	24º C	**Humidity**	33%	**Pressure**	998mbar
Frequency Range	9kHz – 1000 MHz						
Perf. Criteria	Class B (Below Limit)			**Perf. Verification**	Readings Under Limit		
Mod. to EUT	None			**Test Performed By**	Alexander Sowinski		

4.4.2 Test Procedure

Transmitter spurious emissions tests were performed according to FCC CFR §15.205, §15.209, and §15.225, including methods for signal maximization details in ANSI C63.10. Testing was performed at a measurement distance of 3 meters. The limits below 30 MHz were extrapolated as per FCC CFR §15.31 (f). Any spurious emissions within 20 dB of the applicable limit line were maximized and recorded. The worst case (Z-axis) spurious emissions were reported. No spurious emissions were detected on X or Y-axis.

4.4.3 Deviations

There were no deviations from the test methodology listed in the test plan for the transmitter spurious emissions test.

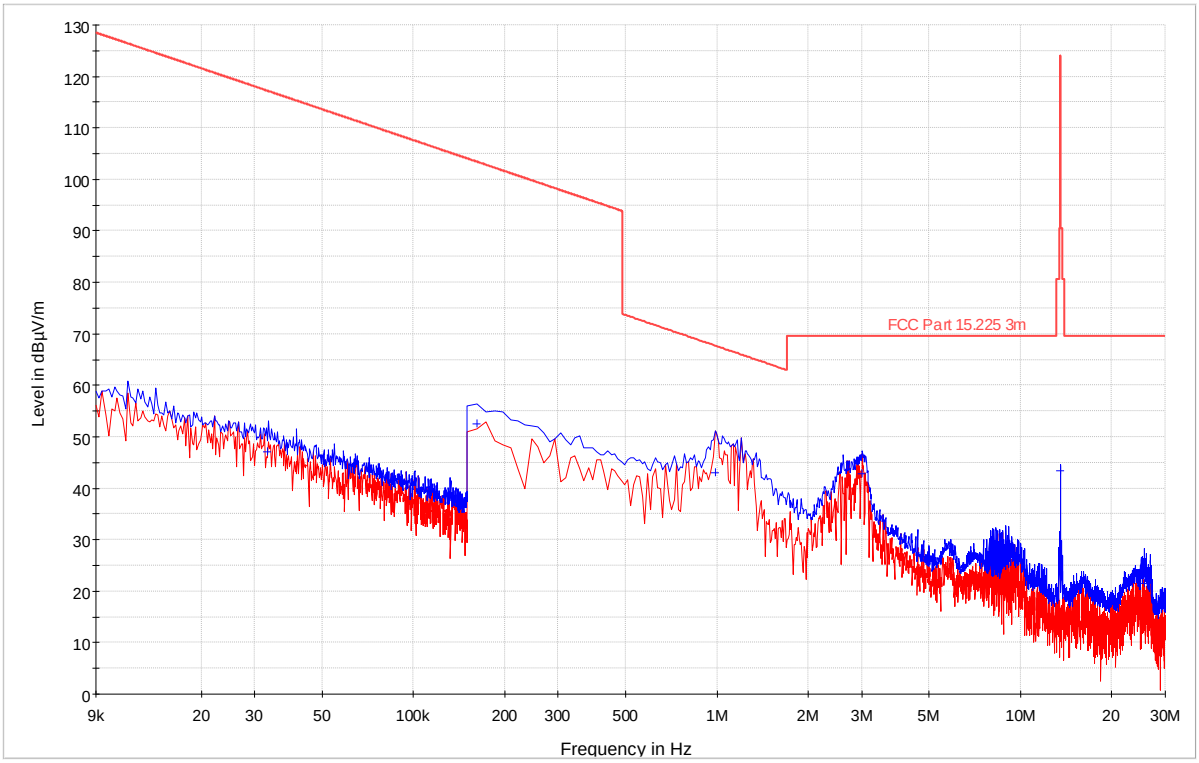
4.4.4 Final Test

The transmitter spurious emissions of the EUT were below the limit specified in the standard.

4.4.5 Final Data

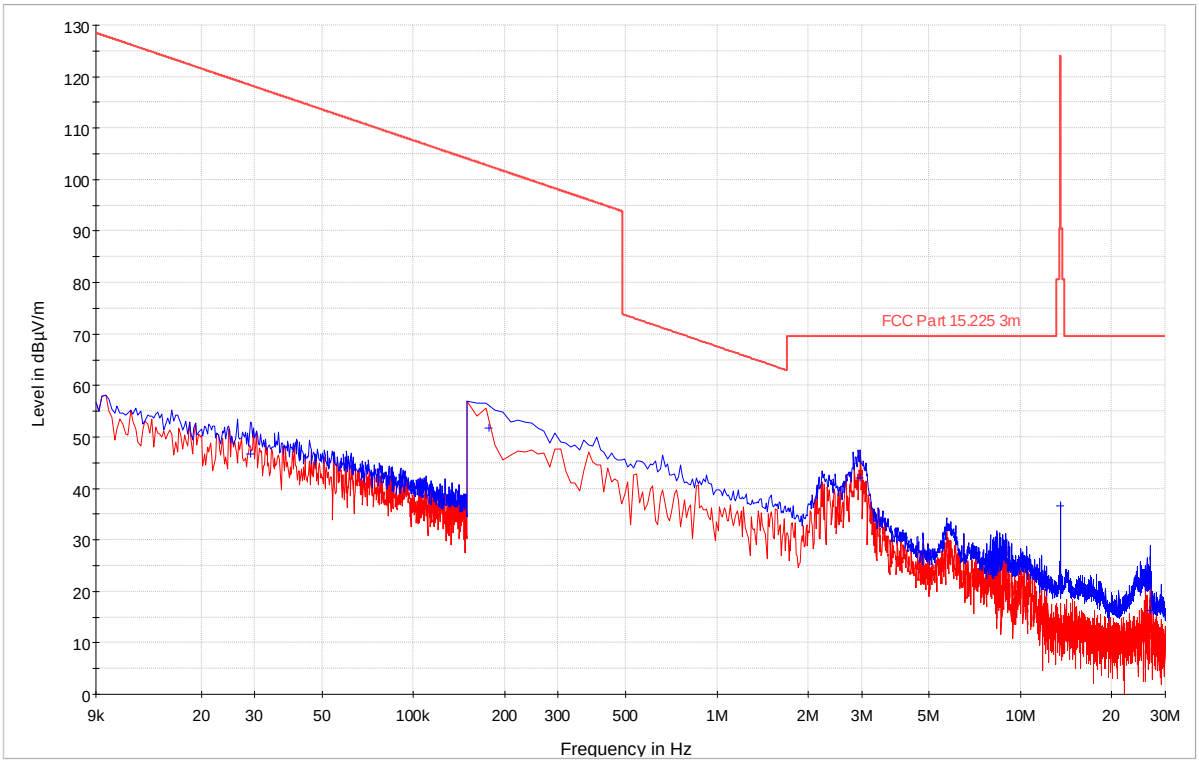
NOTES: 9 kHz – 30 MHz, Z-Axis

Radiated Emissions
Loop Position 0°



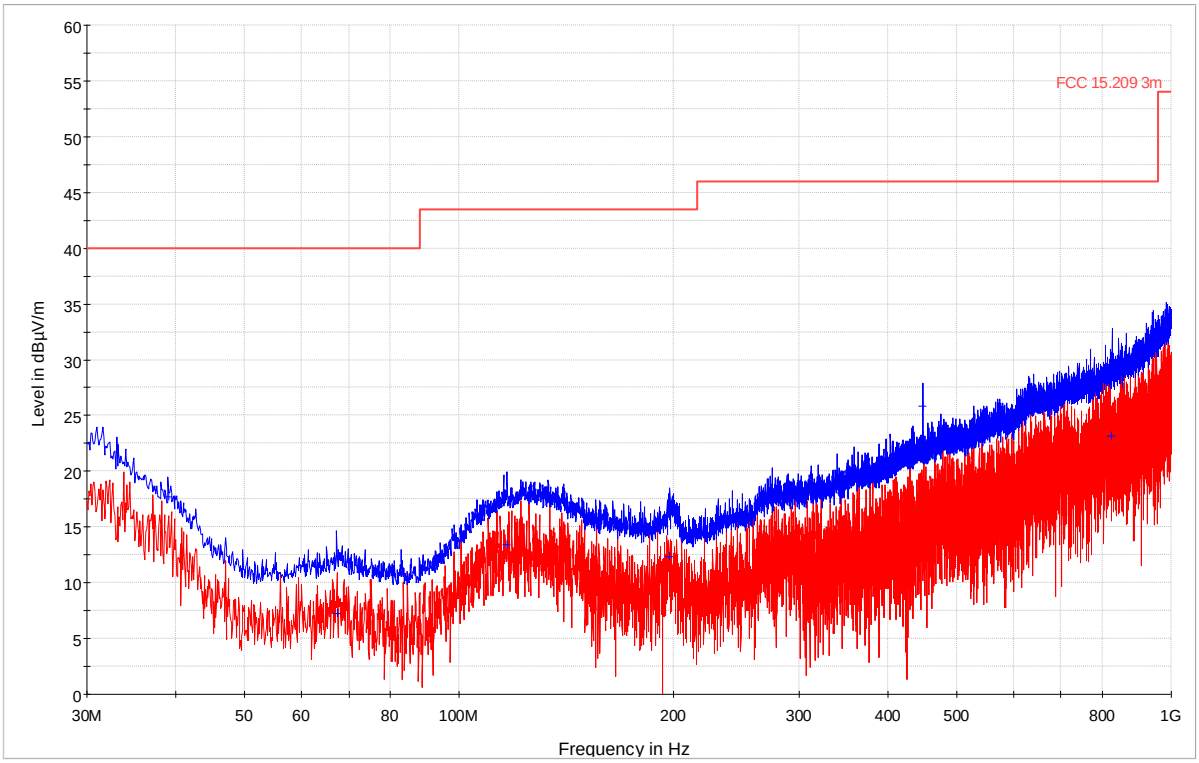
NOTES: 9 kHz – 30 MHz, Z-axis

Radiated Emissions
Loop Position 90°



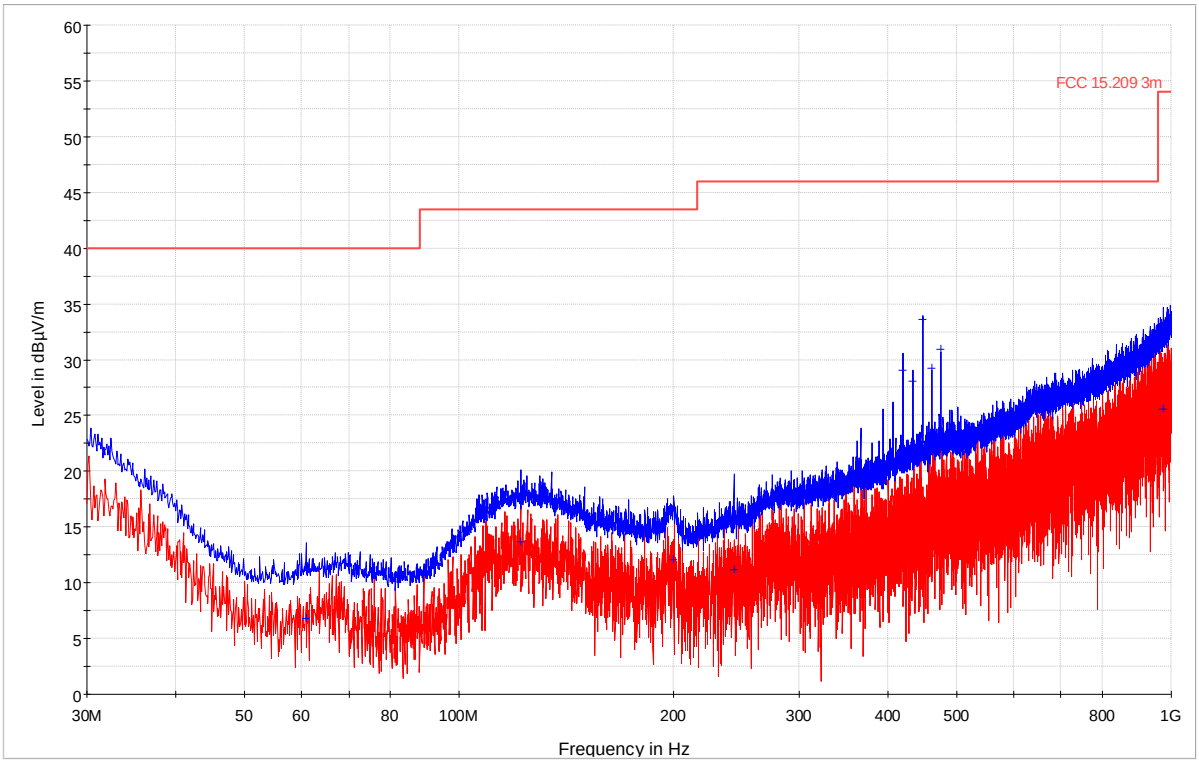
NOTES: 30 – 1000 MHz, Z-Axis

Radiated Emissions
Vertical



NOTES: 30 – 1000 MHz, Z-axis

Radiated Emissions
Horizontal



4.4.6 Final Tabulated Data

Table 1: 9 kHz – 30 MHz Data

Frequency	QuasiPeak	Height	Loop Position	Azimuth	Limit - QPK	Margin
MHz	dBµV/m	cm	deg	deg	dBµV/m	dB
0.029	46.7	100.0	90°	27.0	118.3	-71.6
0.033	47.0	100.0	0°	230.0	117.2	-70.2
0.162	52.5	100.0	0°	245.0	103.4	-50.9
0.178	51.7	100.0	90°	181.0	102.6	-50.9
0.986	43.1	100.0	0°	101.0	67.7	-24.6
2.968	42.0	100.0	90°	94.0	69.5	-27.5
3.016	42.8	100.0	0°	358.0	69.5	-26.7
13.560	43.4	100.0	0°	195.0	124.0	-80.6
13.560	36.6	100.0	90°	288.0	124.0	-87.4
25.570	21.4	100.0	0°	195.0	69.5	-48.1
26.740	16.3	100.0	90°	221.0	69.5	-53.2

Table 2: 30 – 1000 MHz Data

Frequency	QuasiPeak	Height	Polarization	Azimuth	Limit - QPK	Margin
MHz	dBµV/m	cm		deg	dBµV/m	dB
39.04	17.7	100.0	V	168.0	40.0	-22.3
60.96	6.8	250.0	H	282.0	40.0	-33.2
67.32	7.3	100.0	V	303.0	40.0	-32.7
116.72	13.4	100.0	V	10.0	43.5	-30.1
122.04	13.6	250.0	H	-3.0	43.5	-29.9
197.60	12.3	100.0	V	3.0	43.5	-31.2
200.20	12.1	250.0	H	2.0	43.5	-31.4
243.16	11.2	250.0	H	87.0	46.0	-34.8
420.36	29.0	225.0	H	194.0	46.0	-17.0
433.92	28.1	225.0	H	10.0	46.0	-17.9
447.48	25.8	100.0	V	286.0	46.0	-20.2
447.48	33.7	225.0	H	192.0	46.0	-12.3
461.04	29.2	225.0	H	204.0	46.0	-16.8
474.60	30.9	225.0	H	3.0	46.0	-15.1
825.28	23.2	100.0	V	2.0	46.0	-22.8
974.40	25.6	225.0	H	214.0	54.0	-28.4

4.5 Frequency Stability

In accordance with 47 CFR Part 15.225(e) the frequency stability of RFID devices must be such that an emission is maintained within the band of operation between -20 and 50°C.

4.5.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	03/17/2020	
Standard	FCC CFR 47 §15.225 (e)						
Product Model	Token			**Serial#**	0001		
Configuration	See test plan for details.						
Test Set-up	Tested in shielded room, EUT placed on table. See test plan for details						
EUT Powered By	4 VDC	**Temp**	22º C	**Humidity**	34%	**Pressure**	1002 mbar
Temp range	-20 – 50°C						
Perf. Criteria	Carrier within ±0.01%			**Perf. Verification**	See test plan		
Mod to EUT	None			**Test Performed By**	Alexander Sowinski		

4.5.2 Test Procedure

EUT was placed inside temperature chamber and allowed to reach desired temperature. Measurements were then taken radiated via nearby loop antenna connected to a spectrum analyzer.

4.5.3 Deviations

There were no deviations from the test methodology listed in the test plan for the frequency stability test.

4.5.4 Final Test

The EUT maintained frequency stability across all measured temperatures.

4.5.5 Final Data

Table 3: Frequency stability data

Ambient Temperature [°C]	Measured Center Frequency [MHz]	Maximum deviation	Lower Limit [MHz]	Upper Limit [MHz]	Result
-20	13.56056	±0.01%	13.55864	13.56136	Pass
22	13.56036	±0.01%	13.55864	13.56136	Pass
50	13.56022	±0.01%	13.55864	13.56136	Pass

4.5.6 Sample Frequency Stability Plot

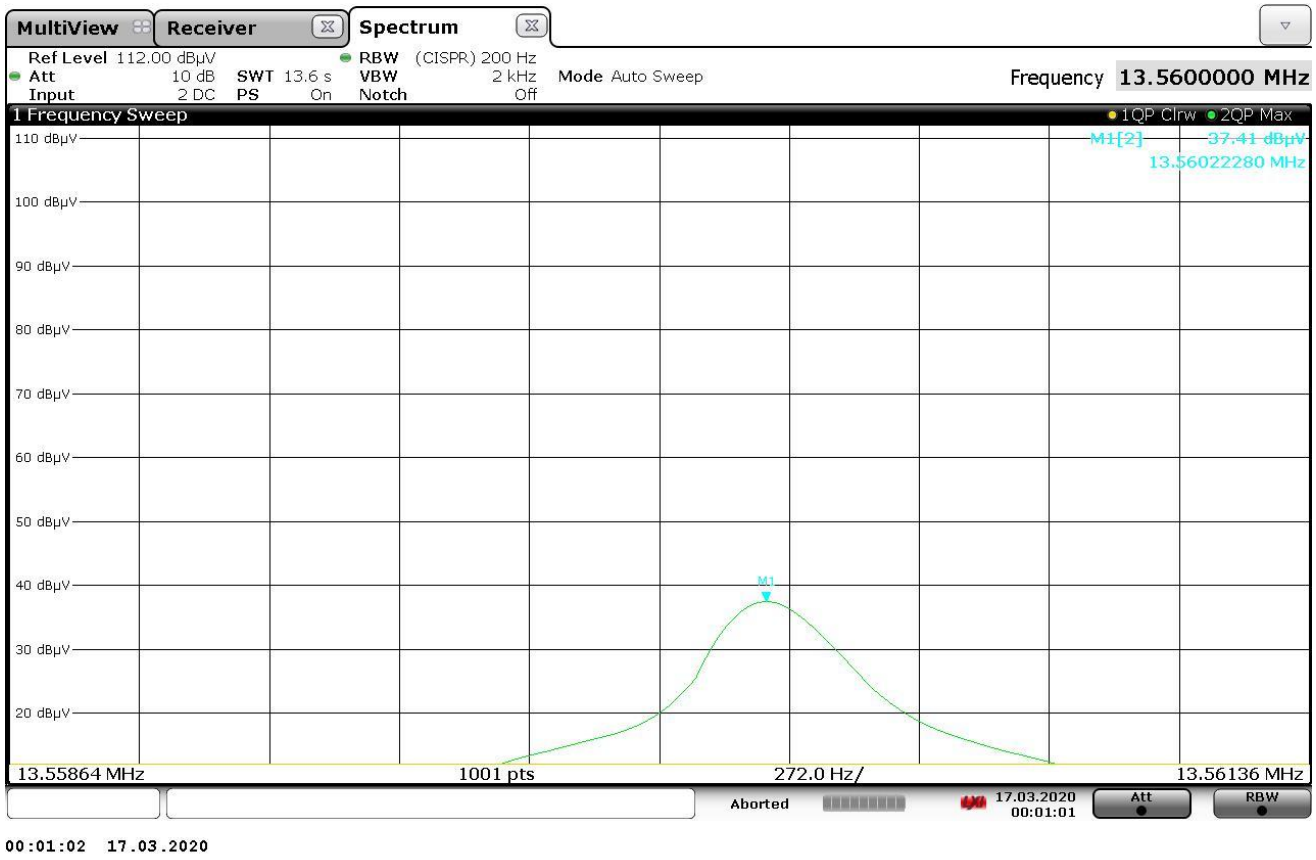


Figure 5 – Sample frequency stability plot

4.6 Voltage Variation

In accordance with 47 CFR Part 15.225(e) the frequency stability of RFID devices must be such that an emission is maintained within the band of operation between 85 – 115% nominal supply voltage.

4.6.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	03/16/2020	
Standard	FCC CFR 47 §15.225 (e)						
Product Model	Token			**Serial#**	0001		
Configuration	See test plan for details.						
Test Set-up	Tested in shielded room, EUT placed on table. See test plan for details						
EUT Powered By	4 VDC nominal	**Temp**	24º C	**Humidity**	33%	**Pressure**	998mbar
Voltage range	3.65 – 4.35 VDC						
Perf. Criteria	Carrier within ±0.01%			**Perf. Verification**	See test plan		
Mod to EUT	None			**Test Performed By**	Alexander Sowinski		

4.6.2 Test Procedure

EUT was placed on a test bench and connected to a DC power supply. Measurements were then taken radiated via nearby loop antenna connected to a spectrum analyzer.

4.6.3 Deviations

There were no deviations from the test methodology listed in the test plan for the voltage variation test.

4.6.4 Final Test

The EUT maintained frequency stability across all applied voltages.

4.6.5 Final Data

Table 4: Voltage variation data

Applied Voltage [V]	Measured Center Frequency [MHz]	Maximum deviation	Lower Limit [MHz]	Upper Limit [MHz]	Result
3.65	13.56037	±0.01%	13.55864	13.56136	Pass
4	13.56036	±0.01%	13.55864	13.56136	Pass
4.35	13.56036	±0.01%	13.55864	13.56136	Pass

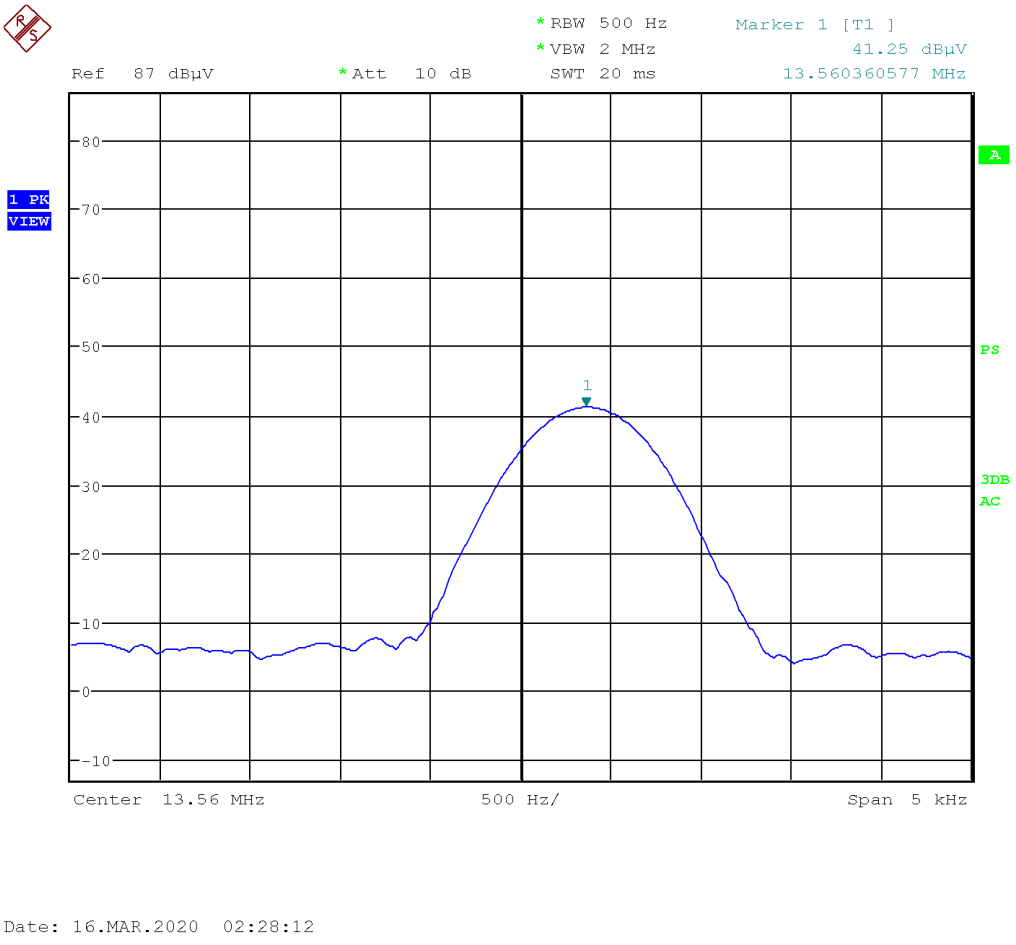


Figure 6 – Sample voltage variation plot

Appendix A

5 Test Plan

This test report is intended to follow the test plan outlined herein unless otherwise stated. The test plan provides product information, reference standards, and testing details. The product information below came via client, product manual, product itself and or the internet. Test procedure information will reference standards or internal TUV Rheinland NA procedures.

5.1 General Information

Client	Tokenize Inc.
Address 1	4545 East River Road
Address 2	West Henrietta, NY, 14586
Contact Person	Richard Lourette
Telephone	585-953-5309
Fax	--
e-mail	richard@tokenring.com

5.2 Model(s) Name

Token

5.3 Type of Product

Biometrically-Secured Ring

5.4 Equipment Under Test (EUT) Description

Token replaces your keys, cards, passwords, and badges with a biometrically-secured ring, so that you can prove your identity safely and easily.

Token is a ring and is offered in several sizes 6-12 for example, with different finish platings.

Sample "0001" was used for all radiated tests.

5.5 Wireless

☒	**Yes**	☐	**No**

EUT Wireless Details	
FCC ID:	2AVVU-TOKEN-01
Environment:	Portable
Operating Temperature Range:	-20 – 50°C
Multiple Feeds:	☒ No ☐ Yes, and how many:
Hardware Version:	Token1
Software Version:	V1.0
Transmitter Frequency Band:	13.56 MHz
Power Setting:	Maximum
Antenna Type and Gain:	Loop, 0dBi
Modulation Type:	NFC - OOK
Data Rate:	106 kbps
Max Duty Cycle:	100%
Type of Equipment:	Portable, worn on body (finger).

5.6 General Product Information

Size	**H**	10 mm	**W**	27.6 mm	**L**	27.6 mm
Weight	< 10 g		**Fork-Lift Needed**		No	
Notes						

5.7 Modifications

For the purpose of testing only an external battery was attached to the sample to maintain continuous transmissions. A LED was also connected to the EUT for easier determination of operating mode.

5.8 EUT Electrical Power Information

5.8.1 Electrical Power Type

☐	**AC**	☐	**DC**	☒	**Batteries**	☐	**Host -**

5.8.2 Electrical Power Information

Name	Type	Voltage		Frequency	Current	Notes
		min	max			
Internal Battery	Li-ion	3.65	4.35	DC	< 20 mA	
Notes	Nominal voltage 4 VDC					

5.9 EUT Modes of Operation during Testing

For the purpose of this testing, EUT was configured to transmit at maximum output power in short bursts. A 25% duty cycle was utilized for continuous transmission modes.

5.10 EUT Clock/Oscillator Frequencies

Please specify the maximum clock frequency used in the product – _____48 MHz_____

In the table below, please specify other clock frequencies and sensitive operating frequencies in the product.

Clock Frequencies & Sensitive Frequencies
48MHz (CPU)
48MHz (Bluetooth xtal)
27.12MHz (NFC external oscillator)
6.78MHz (charger oscillator)

5.11 Electrical Support Equipment

Type	Manufacturer	Model	Connected To
External Battery	Generic 4000mAh	18650	Token DC supply
Cell Phone	Nokia	TA-1085	Token BLE
LED Indicator	ROHM	SMPL34	Token

5.12 Non - Electrical Support Equipment

Item	Notes
Gas	None
Water	None
Air	None

5.13 EUT Equipment/Cabling Information

EUT Port	Connected To	Location	Cable Type		
			Length	Shielded	Bead
None	N/A	N/A	N/A	N/A	N/A

5.14 Emissions

5.14.1 Carrier Field Strength Test

5.14.1.1 Carried Field Strength Test Set-up

Standard	FCC CFR 47 §15.225 (a)			**TUV Test Procedure**	MS-0005082
Limit	< 124 dBµV/m @ 3 meters	**Emissions Verification**			Emission Under Limit
Frequency Range	13.56 MHz	**Ant Dist**	3m	**Det**	QP
Scan #1	Final scan				
Configuration	See Appendix A, EUT Configuration				
EUT Powered By	See Appendix A, EUT Electrical Power Information				
Notes	None				

5.14.2 Occupied Bandwidth Test

5.14.2.1 Occupied Bandwidth Test Set-up

Standard	FCC CFR 47 §15.215 (c)			**TUV Test Procedure**	MS-0005180
Limit	99% and 6dB OBW must fall within 13.553 – 13.567 MHz	**Emissions Verification**			Carrier Within Limit
Frequency Range	13.553 – 13.567 MHz	**Ant Dist**	**3m**	**Det.**	**QP**
Scan #1	Final Scan				
Configuration	See Appendix A, EUT Configuration				
EUT Powered By	See Appendix A, EUT Electrical Power Information				
Notes	None				

5.14.3 Out of Band Emissions Test

5.14.3.1 Out of Band Emissions Test Set-up

Standard	FCC CFR 47 §15.225 (b, c)	**TUV Test Procedure**			MS-0005180
Frequency Range	13.553 – 13.567 MHz	**Limit**			< 124 dBµV/m @ 3m
	13.410 – 13.553 MHz 13.567 – 13.710 MHz				< 90.5 dBµV/m @ 3m
	13.110 – 13.410 MHz 13.710 – 14.010 MHz				< 80.5 dBµV/m @ 3m
Test Range	13.110 – 14.010 MHz	**Ant Dist**	**3m**	**Det.**	**QP**
Scan #1	Final Scan				
Configuration	See Appendix A, EUT Configuration				
EUT Powered By	See Appendix A, EUT Electrical Power Information				
Notes	None				

5.14.4 Transmitter Spurious Emissions Test

5.14.4.1 Transmitter Spurious Emissions Test Set-up

Standard	FCC CFR 47 §15.225 (d); §15.209	**TUV Test Procedure**			MS-0005180
Frequency Range	9 – 490 kHz	**Limit**			< 20log(2400/F) + 80 dBµV/m @ 3m
	490 – 1705 kHz				< 20log(24000/F) + 80 dBµV/m @ 3m
	1.705 – 30 MHz				< 69.5 dBµV/m @ 3m
	13.110 – 14.010 MHz				See 5.14.3.1
	30 – 88 MHz				< 40.0 dBµV/m @ 3m
	88 – 216 MHz				< 43.5 dBµV/m @ 3m
	216 – 960 MHz				< 46.0 dBµV/m @ 3m
	> 960 MHz				< 54.0 dBµV/m @ 3m
Test Range	9 kHz – 1000 MHz	**Ant Dist**	**3m**	**Det.**	**QP**
Scan #1	Final Scan				
Configuration	See Appendix A, EUT Configuration				
EUT Powered By	See Appendix A, EUT Electrical Power Information				
Notes	Limits below 30 MHz extrapolated per CFR 47 §15.31 (f)				

5.14.5 Frequency Stability Test

5.14.5.1 Frequency Stability Test Set-up

Standard	FCC CFR 47 §15.225 (e)	**TUV Test Procedure**			MS-0005180
Limit	Carrier frequency within ±0.01% of nominal	**Emissions Verification**			Carrier within Limits
Frequency Range	13.55864 - 13.56136 MHz	**Ant Dist**	**3m**	**Det.**	**QP**
Scan #1	Final Scan				
Configuration	See Appendix A, EUT Configuration				
EUT Powered By	See Appendix A, EUT Electrical Power Information				
Notes	None				

5.14.6 Voltage Variation Test

5.14.6.1 Voltage Variation Test Set-up

Standard	FCC CFR 47 §15.225 (e)	**TUV Test Procedure**			MS-0005180
Limit	Carrier frequency within ±0.01% of nominal	**Emissions Verification**			Carrier within Limits
Voltage Range	85 – 115% of nominal VDC	**Ant Dist**	**3m**	**Det.**	**QP**
Scan #1	Final Scan				
Configuration	See Appendix A, EUT Configuration				
EUT Powered By	See Appendix A, EUT Electrical Power Information				
Notes	None				

5.15 EUT Configuration

Configuration	Description
Full Power Mode	100% Duty cycle for 5-9 second bursts
Continuous Mode	25% Duty Cycle
Notes	Due to small size of device, a low duty cycle was used for continuous transmissions to prevent damaging the EUT.

5.16 Block Diagram

END OF REPORT