Certification Test Report

FCC ID: 2AAUJ-R001

FCC Rule Part: 15.225
ISED Canada's Radio Standards Specification: RSS-210

TÜV SÜD Report Number: 16-3026.W06.2A

Manufacturer: Viableware, Inc. DBA TableSafe, Inc.
Model: RAIL2

Test Begin Date: April 27, 2017
Test End Date: August 1, 2017

Report Issue Date: August 2, 2017

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

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This report contains 18 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and ISED Canada's Radio Standards Specification RSS-210 Certification.

1.2 Product description

The RAIL2 is a handheld, touchscreen device that enables restaurant guests to securely self-insert credit, debit or chip enabled cards, auto-calculate the tip, split the bill multiple ways, pay-by-item, complete surveys, and display custom advertisements. RAIL2 communicates seamlessly with existing POS systems. It is enclosed in a cover designed to look like a traditional bill presentation folder used at most full-service restaurants. The product also serves as a platform for marketing, customer loyalty programs, and other consumer related value added services.

The RAIL2 includes a 13.56MHz RFID reader and a 2.4GHz WLAN 802.11b/g radio. This report applies to the 13.56MHz RFID radio only. A separate test report covers the 2.4GHz WIFI operation.

Technical Information:

Frequency Range: 13.56 MHz
Operating channels: 1
Modulation Format: ASK
Antenna Type: Loop antenna
Antenna Gain: N/A
Battery Operating Voltage: 3.8 VDC

Manufacturer Information:
Viableware, Inc. DBA TableSafe, Inc.
12220 - 113th Ave, NE Suite 220
Kirkland, WA 98034
USA

EUT Serial Numbers: A02M100200012L

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

The EUT was tested in XYZ orientations. Only the worst case which is the Y plane is reported in this document. The EUT was configured to produce a continuously modulated signal.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

TÜV SÜD America Inc.
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1921 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC and Innovation, Science and Economic Development (ISED) Canada.

FCC Registered Test Site Number: 637011
ISED Canada Test Site Registration Number: 4175A

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

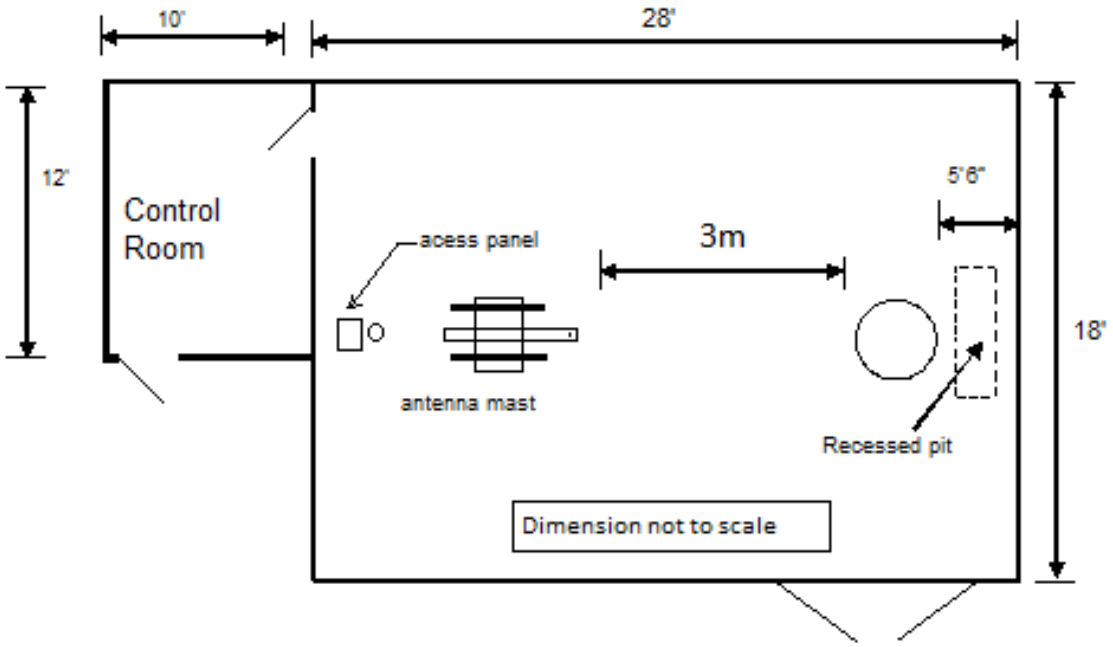

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8’ x 10’ sheet galvanized steel horizontal ground reference plane (GRP) bonded every 6” to an 8’ X 8’ aluminum vertical ground plane.

A diagram of the room is shown below in figure 2.4-1:

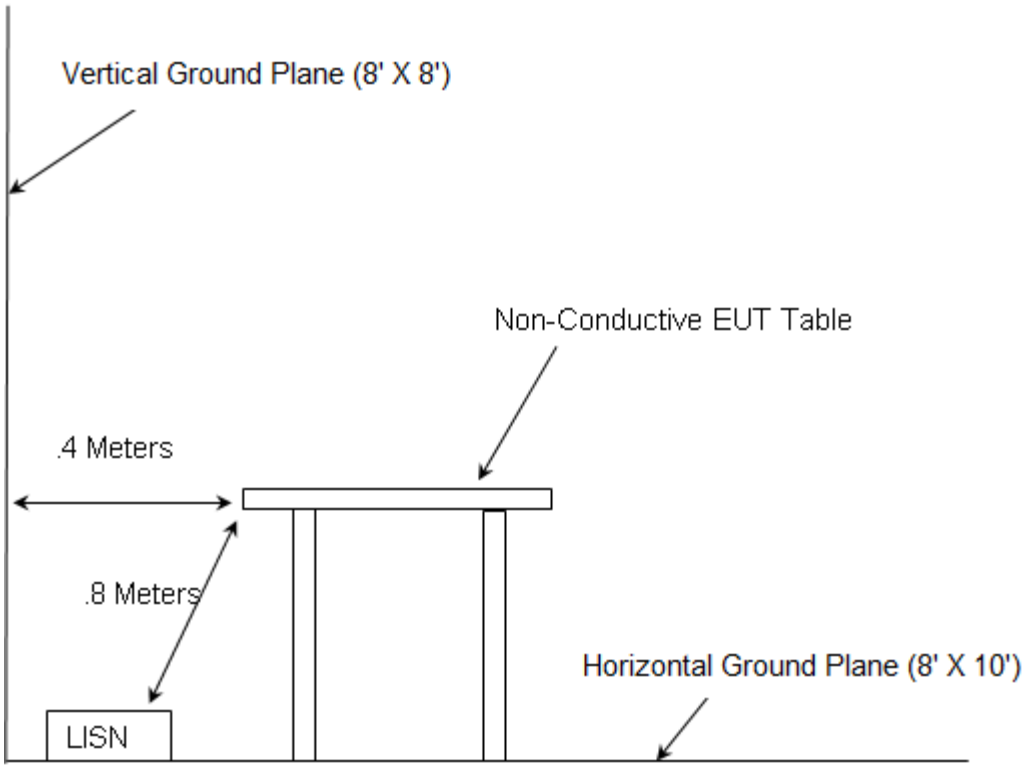

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2017
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2017
- ISED Canada Radio Standards Specification: RSS-210 - License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment, Issue 9, August 2016
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, Nov 2014

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
277	EMCO	93146	Antennas	9904-5199	9/12/2016	9/12/2018
426	Thermotron	S-8 Mini Max	Environmental Chamber	25-2888-10	7/14/2016	7/14/2017*
626	EMCO	3110B	Antennas	9411-1945	3/21/2017	3/21/2019
628	EMCO	6502	Antennas	9407-2877	02/11/2016	02/11/2018
732	Hewlett Packard	8594E	Analyzer	3746A05364	4/18/2017	4/18/2018
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/12/2017	1/12/2018
3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/3/2017	1/3/2018
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/3/2017	1/3/2018
3064	Times	LMR195	Cables	3064	9/16/2016	9/16/2017
3066	Nagoya	NA-771	Antenna	3066	NCR	NCR
RE619	Rhode & Schwarz	ESU26	Spectrum Analyzer	100190	5/12/2017	5/12/2019

NCR = No Calibration Required
Firmware Version: ESU40 is 4.73 SP4
Software Version: EMC32-B is 9.15
* Equipment was used only within the calibration dates listed.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	EUT	TableSafe, Inc.	RAIL2	A02M100200012L

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

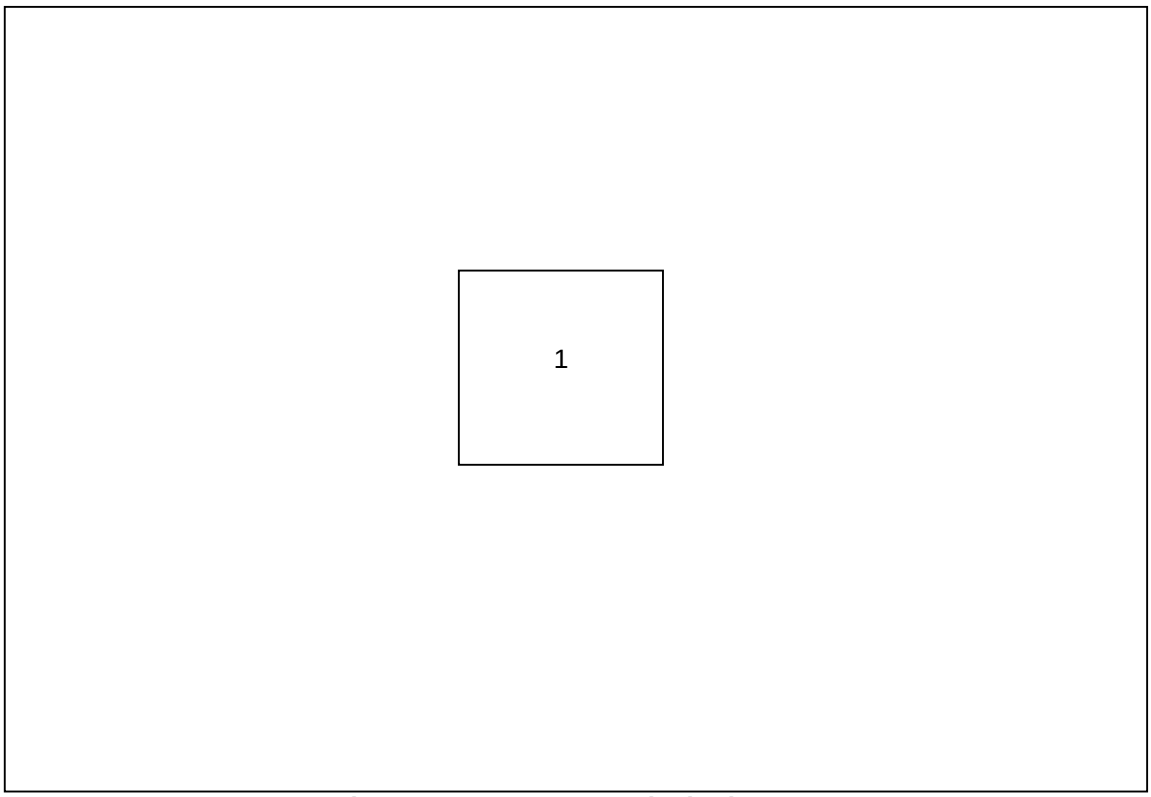

Figure 6-1: Test Setup Block Diagram

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: 15.203

The antenna used for the RAIL2 is an internal antenna which cannot be detached without damaging the unit. Therefore, the antenna meets the requirements of Section 15.203

7.2 Power Line Conducted Emissions – FCC: 15.207; ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

The EUT is battery powered therefore AC power line conducted emissions is not applicable.

7.3 Occupied Bandwidth – FCC Part 15.215(c) / ISED Canada RSS-Gen 6.6

7.3.1 Measurement Procedure

The spectrum analyzer span was set capture all products of the modulation process. The RBW was to 1% - 5% of the estimated bandwidth. The trace was set to max hold with a peak detector active. The marker-delta function was used to determine the 20dB bandwidth. The measurement function of the analyzer was utilized to determine the 99% occupied bandwidth.

7.3.2 Measurement Results

Performed by: Jean Tezil

Table 7.3.2-1: 20dB / 99% Bandwidth

Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
13.56	431.089	743.58

The results are shown in Figure 7.3.2-1 and 7.3.2-2.

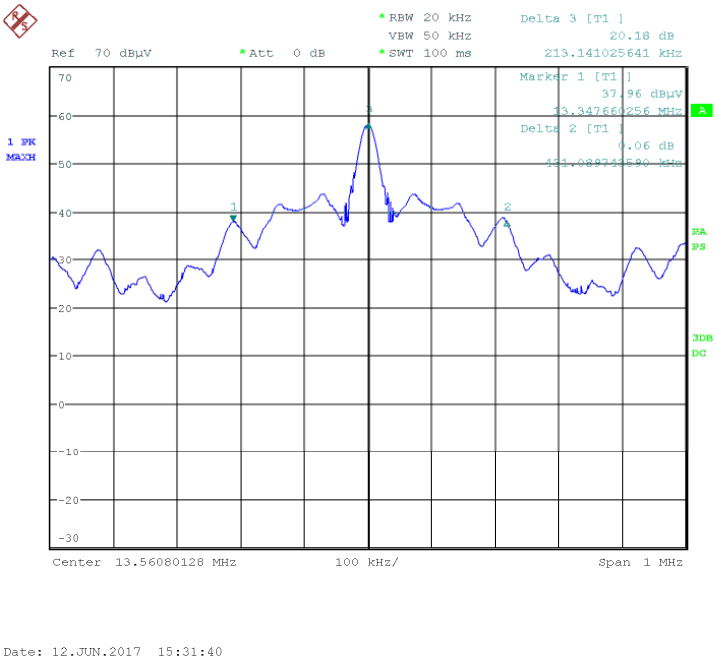

Figure 7.3.2-1: 20dB Bandwidth

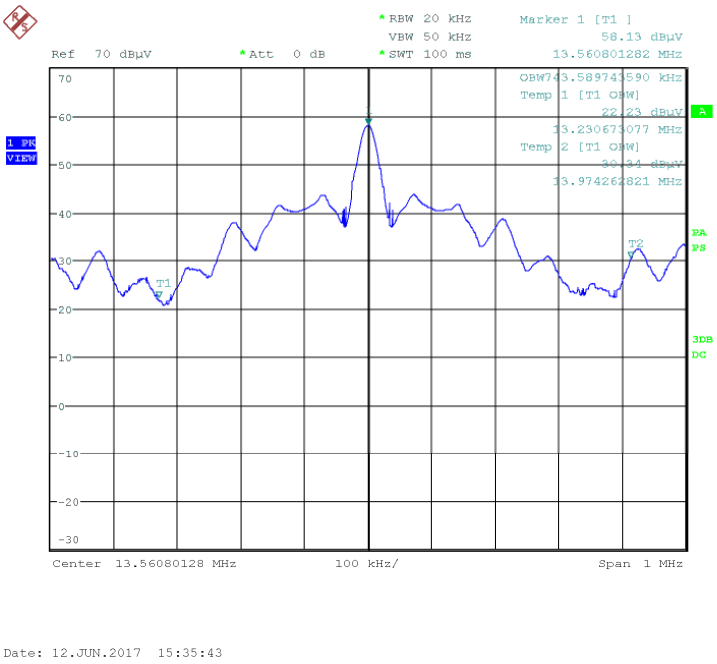

Figure 7.3.2-2: 99% Bandwidth

7.4 Frequency Stability – FCC CFR 47 Part 15.225(e) / ISED Canada RSS-210 B.6

7.4.1 Measurement Procedure

The equipment under test is placed inside an environmental chamber. The RF output is coupled to the input of the measurement equipment via a near field probe.

Frequency measurements were made at the extremes of the of temperature range -20º C to +50º C and at intervals of 10º C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. The maximum variation of frequency was recorded at startup, 2 minutes, 5 minutes, and 10 minutes after the EUT was energized. The maximum variation of frequency was recorded at 85% and 115% of normal supply voltage at nominal temperature. The limit from rule part 15.225 is 0.01% or 100ppm.

7.4.2 Measurement Results

Performed by: Jean Tezil

Results of the test are shown below in Table 7.4.2-1.

Table 7.4.2-1: Frequency Stability

Temperature	Time since startup	Frequency	Frequency Error	Voltage	Voltage
(C)	(Minutes)	(MHz)	(PPM)	(%)	(VDC)
-20 C	0	**13.560590000**	**43.510**	100	3.80
	2	**13.560640000**	**47.198**	100	3.80
	5	**13.560690000**	**50.885**	100	3.80
	10	**13.560640000**	**47.198**	100	3.80
-10 C	0	**13.560640000**	**47.198**	100	3.80
	2	**13.560656000**	**48.378**	100	3.80
	5	**13.560669000**	**49.336**	100	3.80
	10	**13.560656000**	**48.378**	100	3.80
0 C	0	**13.560644000**	**47.493**	100	3.80
	2	**13.560619000**	**45.649**	100	3.80
	5	**13.560619000**	**45.649**	100	3.80
	10	**13.560644000**	**47.493**	100	3.80
10 C	0	**13.560606000**	**44.690**	100	3.80
	2	**13.560594000**	**43.805**	100	3.80
	5	**13.560594000**	**43.805**	100	3.80
	10	**13.560594000**	**43.805**	100	3.80
20 C	0	**13.560594000**	**43.805**	100	3.80
	2	**13.560569000**	**41.962**	100	3.80
	5	**13.560582000**	**42.920**	100	3.80
	10	**13.560569000**	**41.962**	100	3.80
30 C	0	**13.560569000**	**41.962**	100	3.80
	2	**13.560469000**	**34.587**	100	3.80
	5	**13.560469000**	**34.587**	100	3.80
	10	**13.560469000**	**34.587**	100	3.80
40 C	0	**13.560581000**	**42.847**	100	3.80
	2	**13.560557000**	**41.077**	100	3.80
	5	**13.560544000**	**40.118**	100	3.80
	10	**13.560544000**	**40.118**	100	3.80
50 C	0	**13.560569000**	**41.962**	100	3.80
	2	**13.560565000**	**41.667**	100	3.80
	5	**13.560590000**	**43.510**	100	3.80
	10	**13.560619000**	**45.649**	100	3.80

20 C	0	**13.560625000**	**46.091**	85	3.23
	2	**13.560625000**	**46.091**	85	3.23
	5	**13.560637000**	**46.976**	85	3.23
	10	**13.560612000**	**45.133**	85	3.23
	0	**13.560625000**	**46.091**	115	4.37
	2	**13.560625000**	**46.091**	115	4.37
	5	**13.560650000**	**47.935**	115	4.37
	10	**13.560637000**	**46.976**	115	4.37

7.5 Radiated Emissions – Intentional Radiation

7.5.1 In-Band Emissions Limitations – FCC Part 15.225(a),(b),(c) / ISED Canada RSS-210 B.6

7.5.1.1 Measurement Procedure

Measurements below 30MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360º and the loop antenna rotated about the vertical axis to maximize each emission. The magnetic loop receiving antenna was positioned with its center 1 meter above the ground.

The spectrum analyzer's resolution and video bandwidths were set to 9 kHz and 30 kHz respectively. A quasi-peak detector was used. The limits were corrected by a distance correction factor. The measurements were corrected by the antenna correction factors, and cable loss for comparison to the limits. Sample correction factors and calculations can be found section 7.3.2.2 and 7.3.2.4.

7.5.1.2 Measurement Results

Performed by: Jean Tezil

Compliance with the emissions levels are shown in Figure 7.3.1.2-1 below. Measurement Results

Table 7.5.1.2-1: Radiated in-band Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
13.56		63.30	H	10.70	---------	74.00	--------	124.0	--------	50.0
In-band Emissions										
13.41		28.70	H	10.70	---------	39.40	--------	80.5	---------	41.1
13.553		45.50	H	10.70	---------	56.20	--------	90.5	---------	34.3
13.567		50.00	H	10.70	---------	60.70	--------	90.5	---------	29.8
13.71		30.00	H	10.70	---------	40.70	--------	80.5	---------	39.8

Notes:
The worst-case frequency was reported for each range specified in Section 15.225(a), (b), and (c)
The limits were corrected by a distance correction factor calculated using the formula: 40 * Log (30m / 3m)

7.5.2 Out-of-Band Emissions – FCC Part 15.225(d), 15.209, 15.109 / ISED Canada RSS-210 B.6 / RSS-Gen 8.9

7.5.2.1 Measurement Procedure

Section 15.33(a)(4) specifies, if the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to frequency specified in 15.33(b)(1) for unintentional radiators. The upper frequency range for the digital device is 1000MHz which greater than the 10th harmonic of the fundamental frequency. The upper frequency range measured was 1000MHz.

Measurements below 30MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360º and the loop antenna rotated about the vertical axis to maximize each emission. The magnetic loop receiving antenna was positioned with its lowest height at 1 meter above the ground.

For measurements in the frequency bands 9-90 kHz and 110-490 kHz, an average detector was used. When average measurements are specified, the peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. All other emissions were measured using a Quasi-peak detector. The final measurements were then corrected by a distance correction factor, antenna correction factors, and cable loss for comparison to the limits.

Measurements above 30MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made.

The spectrum analyzer's resolution bandwidth was set to equal to or greater than 100 Hz from 9 kHz to 150 kHz, 9 kHz from 150 kHz to 30 MHz, 120 kHz from 30 MHz to 1000 MHz, and 1 MHz from 1 GHz to 40 GHz.

7.5.2.2 Distance Correction for Measurements Below 30 MHz – Part 15.31

Radiated measurements were performed at a distance closer than 30m as required according to Part 15.209. Therefore a correction factor was applied to account for propagation loss at the specified distance. The propagation loss was determined by using the square of an inverse linear distance extrapolation factor (40dB/decade) according to 15.31. A sample calculation of the distance correction factor is shown below for limits expressed at a 30m measurement distance.

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (3/30)
= - 40 dB

7.5.2.3 Measurement Results

Performed by: Jean Tezil

Radiated spurious emissions found are reported in Table 7.5.2.3-1.

Table 7.5.2.3-1: Radiated Spurious and Non-Spurious Emissions - Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
13.063		23.20	H	10.70	---------	33.90	--------	69.5	---------	35.6
14.056		25.90	H	10.70	---------	36.60	--------	69.5	---------	32.9
40.68		4.70	H	11.39	---------	16.09	--------	40.0	---------	23.9
40.68		18.00	V	11.39	---------	29.39	--------	40.0	---------	10.6
54.24		0.01	H	9.93	---------	9.94	--------	40.0	---------	30.1
54.24		3.70	V	9.93	---------	13.63	--------	40.0	---------	26.4
67.8		1.50	H	9.80	---------	11.30	--------	40.0	---------	28.7
67.8		5.10	V	9.80	---------	14.90	--------	40.0	---------	25.1
81.36		7.00	H	9.75	---------	16.75	--------	40.0	---------	23.2
81.36		8.40	V	9.75	---------	18.15	--------	40.0	---------	21.8
869.6		20.80	H	24.70	---------	45.50	--------	46.0	---------	0.5
905.93		21.50	H	23.90	---------	45.40	--------	46.0	---------	0.6

Notes:
All the frequencies not listed were attenuated below the limits and the noise floor level of the equipment.

7.5.2.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Quasi-Peak

Corrected Level: 23.2dBuV + 10.7dB = 33.9dBuV/m
Margin: 69.5dBuV/m – 33.9dBuV/m = 35.6dB

8 MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Parameter	U_{lab}
Occupied Channel Bandwidth	**± 0.004%**
RF Conducted Output Power	**± 0.689 dB**
Power Spectral Density	**±0.5 dB**
Antenna Port Conducted Emissions	**± 2.717 dB**
Radiated Emissions	**± 5.877 dB**
Temperature	**± 0.860 °C**
Radio Frequency	**±2.832 x 10-8**
AC Power Line Conducted Emissions	**±2.85**

9 CONCLUSION

In the opinion of TÜV SÜD America Inc. the RAIL2, manufactured by Viableware, Inc. DBA TableSafe, Inc. meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-210 for the tests documented herein.

END REPORT