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## ENGINEERING TEST REPORT #: 316280 LSR JOB #: C-2557

### Compliance Testing of:

VS1000

### Test Date(s):

10/12/2016 10/18/2016  
10/13/2016 10/19/2016

### Prepared For:

Vulture Systems, LLC  
Attn: Gregg Haensgen  
1764 Koshkonong Rd  
Stoughton, WI 53589

### **This Test Report is issued under the Authority of:**

John Johnston, EMC Engineer

Signature: 

Date: 10/20/16

### **Reviewed by:**

Adam Alger, Quality Systems Engineer

Signature: 

Date: 10-24-16

### **Project Engineer:**

John Johnston, EMC Engineer I

Signature: 

Date: 10/20/16

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## LS Research, LLC in Review

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

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TESTING CERT #1255.01

### A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope of Accreditation  
A2LA Certificate Number: 1255.01

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### Federal Communications Commission (FCC) – USA

Listing of two 3 Meter Semi-Anechoic Chambers based on Title 47 CFR – Part 2.948  
FCC Registration Number: 90756

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### Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-GEN – Issue 4

File Number: IC 3088A-2

On file, 3 Meter Semi-Anechoic Chamber based on RSS-GEN – Issue 4

File Number: IC 3088A-3

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## **Summary of Test Report**

Between October 12, 2016 and October 19, 2016 the VS1000, provided by Vulture Systems LLC, was tested and MEETS the following requirements:

<b>FCC and IC Paragraph</b>	<b>Test Requirements</b>	<b>Compliance (Yes/No)</b>
FCC: 15.247 (a)(2) IC: RSS-247 sect. 5.2 (1) IC: RSS-Gen sect. 6.6	Minimum 6 dB Bandwidth / Occupied Bandwidth	Yes
FCC: 15.247 (b)(3) & 1.1310 IC: RSS-247 sect. 5.4 (4)	Maximum Output Power	Yes
FCC: 15.247 (e) IC: RSS-247 sect. 5.2 (2)	Power Spectral Density of a Digitally Modulated System	Yes
FCC: 15.247(d) IC: RSS-247 sect. 5.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC: 15.209 & 15.205 IC: RSS-Gen sect 6.13	Transmitter Radiated Emissions	Yes
FCC: 2.1055 (d) IC: RSS Gen sect. 6.11	Frequency Stability	Yes
FCC: 15.207 IC: RSS GEN sect. 8.8	AC Power Line Conducted Emissions	N/A <sup>1</sup>

## **Test Facilities**

All testing was performed at:

LS Research, LLC  
W66 N220 Commerce Court  
Cedarburg, Wisconsin, 53012 USA

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to the requirements of ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

<sup>1</sup> AC Line conducted emission testing not required for battery operated devices

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## 1.0 Client Information

<b>Manufacturer Name:</b>	Vulture Systems, LLC
<b>Address:</b>	1764 Koshkonong Rd
<b>Contact Person:</b>	Gregg Haensgen

### 1.1 Equipment Under Test (EUT) Information

<b>Product Name:</b>	VS1000
<b>Model Number:</b>	VS1000
<b>Serial Number:</b>	001/002

### 1.2 Product Information

The VS1000, referred to herein as an “equipment under test,” or “EUT,” is a handheld transceiver designed to monitor for Vulture Systems base units (i.e., VS2000) in a VultureNet system. The VS1000 is powered by two AAA batteries in series that present a 3.0 V nominal voltage to the board. The VS1000 includes a Semtech SX1272 LoRa radio configured to transmit at a fixed 922 MHz and exhibits a 500 kHz channel bandwidth.

### 1.3 Modifications Incorporated In the EUT for Compliance Purposes

None.

### 1.4 Deviations & Exclusions from Test Specifications

None noted at time of test.

### 1.5 Additional Information

It should be noted that conducted measurement testing was performed on EUT serial number 001, which includes an impedance matching SMA connector. Moreover, the radiated emission testing was performed on EUT serial number 002.

Test operational modes (transmit, receive, continuous wave) were instantiated by pressing and holding one of six momentary switch push buttons on the EUT before power up. Firmware version 7.0.0 was implemented on the VS1000.

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## **1.6 Conditions of Test**

Environmental:

Temperature: 20-25° C  
Relative Humidity: 30-60%  
Atmospheric Pressure: 86-106 kPa

## **1.7 Test Equipment**

All test equipment is calibrated by a calibration laboratory accredited by A2LA to the requirements of ISO 17025. For a complete list of test equipment and calibration dates, see Appendix A. Unless otherwise noted, resolution bandwidth of measuring instrument used during testing for given frequency range, see below.

<b>Frequency Range</b>	<b>Resolution Bandwidth</b>
9 kHz – 150 kHz	200 Hz
150 kHz – 30 MHz	9 kHz
30 MHz – 1000 MHz	120 kHz
Above 1000 MHz	1 MHz

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## 1.8 EUT Technical Specifications

LoRa:

EUT Frequency Range (in MHz)	922 MHz
EIRP (Conducted Measurement)	0.0675 W
Conducted Output Power, Average	16.29 dBm
DTS Occupied Bandwidth (-6 dB)	0.762 MHz
99% Bandwidth	0.630 MHz
Type of Modulation	Chirp Spread Spectrum
Emission Designator	630KX1D
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Transmitter Spurious (worst case) at 3 meters	53.68 dBuV/m (at 7376 MHz)
Antenna Information	
Detachable/non-detachable	Non-detachable
Type	Chip
Gain	2 dBi
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	247
Modular Filing?	No

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## **2.0 Conformance Summary**

When tested on the specified dates, it was determined that the EUT was compliant with the requirements of FCC Title 47, CFR Part 15.247, 15.205, 15.209, and Industry Canada RSS-247, Issue 1 (2015), RSS-Gen Issue 4 (2014) using the methods of ANSI C63.10 (2013).

Any modifications made to the EUT after the specified test date(s) will invalidate the data herein.

If some measurements are seen to be within the uncertainty value, as listed in Appendix C there is a possibility that this unit may not meet the required limit specification if subsequently tested.

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### 3.0 – RF Conducted Measurements

<b>Manufacturer</b>	Vulture Systems, LLC
<b>Test Location</b>	LS Research, LLC
<b>Rule Part</b>	FCC Part 15.247 / RSS-247
<b>General Measurement Procedure</b>	ANSI C63.10-2013
<b>General Description of Measurement</b>	<p>A direct measurement of the transmitted signal was performed at the antenna port of the EUT via a cable connection to a spectrum analyzer. A 10 dB attenuator was placed in series with the cable to protect the spectrum analyzer. The attenuator was added on the analyzer as gain offset settings thereby allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode while being supplied with typical data as a modulation source and transmitting either a continuous wave or modulated signal based on the test performed. Conducted measurements were performed on EUT S/N 001, which included an SMA connector at the antenna port.</p> <p>Conducted measurements were performed with the EUT operating at a 3.0 V nominal voltage supplied by two AA batteries.</p>

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### 3.1 – RF Conducted – Fundamental Bandwidth

<b>Manufacturer</b>	Vulture Systems, LLC
<b>Date</b>	10/12/2016
<b>Operator</b>	John Johnston
<b>Temp. / R.H.</b>	20 - 25° C / 30-60% R.H.
<b>Rule Part</b>	FCC Part 15.247 (a)(2) / RSS-247 sect. 5.2 (1)
<b>Specific Measurement Procedure</b>	ANSI C63.10 Sections 6.9.3 and 11.8.1 RSS-GEN Section 6.6
<b>Additional Description of Measurement</b>	Peak detector used
<b>Additional Notes</b>	1. Continuous modulated transmit used for this test.

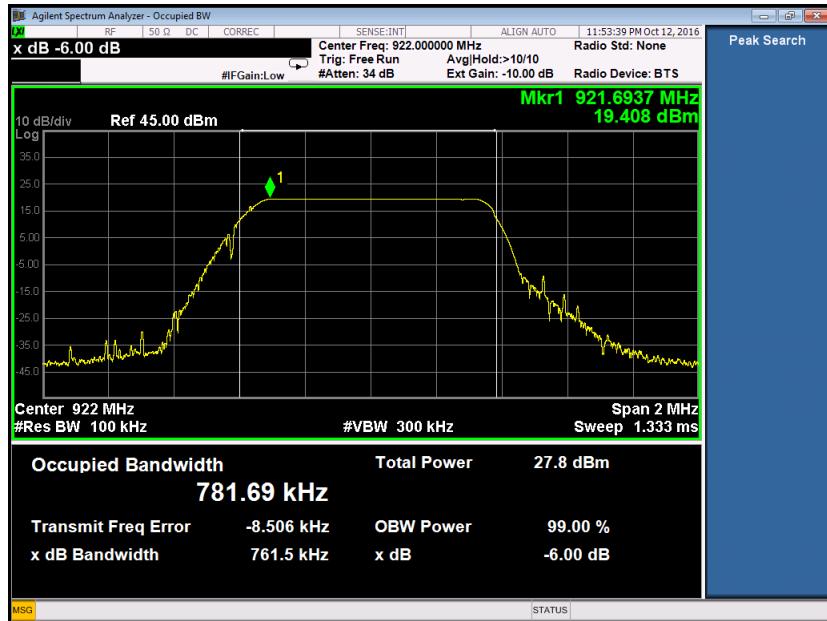
**Table**

Frequency (MHz)	DTS (6 dB) Bandwidth (MHz)	DTS (6 dB) Bandwidth Minimum Limit (MHz)	99% Bandwidth (MHz)	20 dB Bandwidth (MHz)
922	0.762	0.500	0.630	0.708

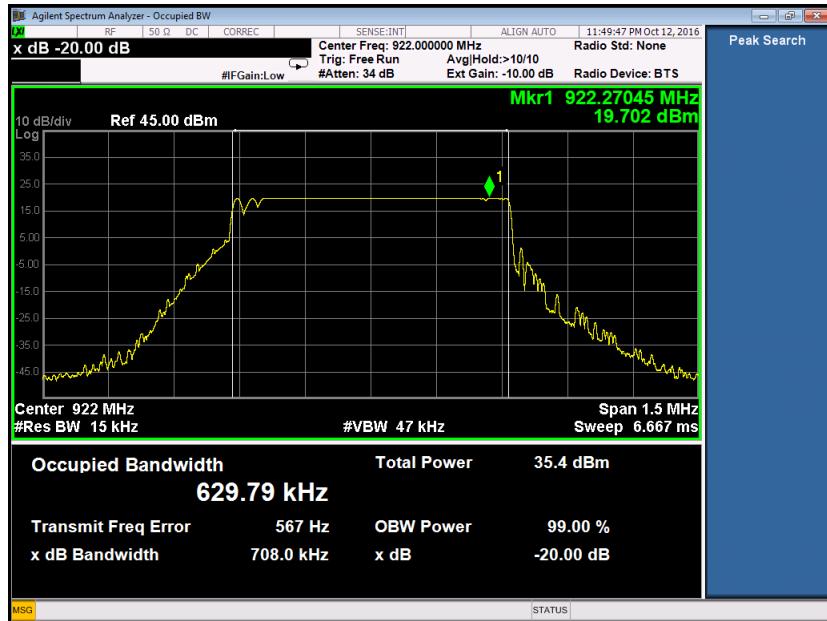
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## Plots

### 922 MHz – DTS (-6dB) BW



### 922 MHz – 99% and 20 dB BW



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### 3.2 – RF Conducted – Fundamental Power and Spectral Density

<b>Manufacturer</b>	Vulture Systems, LLC
<b>Date</b>	10/19/2016
<b>Operator</b>	Kimberly Bay
<b>Temp. / R.H.</b>	20 - 25° C / 30-60% R.H.
<b>Rule Part</b>	FCC 15.247(b)(3)/ FCC 15.247(e) / RSS-247 Section 5.4(3)/ RSS-247 Section 5.2(2)
<b>Specific Measurement Procedure<sup>2</sup></b>	ANSI C63.10 Section 11.9.2.2.4 (Method AVGSA-2) ANSI C63.10 Section 11.10.5 (Method AVGPSD-2)
<b>Additional Description of Measurement</b>	Average Output Power and Average PSD methods utilized for measurement 10 kHz resolution bandwidth used for Peak Power Spectral Density measurement
<b>Additional Notes</b>	1. Continuous transmit modulated used for this test. Sample Calculation: Margin (dB) = Limit – Measured Level

**Table**

Frequency (MHz)	Max Average Conducted Output Power (dBm)	Duty Cycle Correction <sup>3</sup> (dB)	Corrected Max Average Conducted Output Power (dBm)	Power Limit (dBm)	Output Power Margin (dB)	EIRP (dBm) <sup>4</sup>	EIRP Limit (dBm)	EIRP Margin (dB)
922	15.46	0.83	16.29	30	13.71	18.29	36	17.71

Corrected Average Output Power = Average conducted output power + Duty Cycle Correction

Frequency (MHz)	Max Average PSD (dBm)	Duty Cycle Correction <sup>3</sup> (dB)	Corrected Max Average PSD (dBm)	PSD Limit in 3 kHz RBW (dBm)	Margin (dB)
922	1.90	0.83	2.73	8	5.27

Corrected Average PSD = Average PSD + Duty Cycle Correction

<sup>2</sup> The test methods used were based on duty cycle measurements provided in section 3.5 of this report

<sup>3</sup> The duty cycle correction factor is derived using an equation provided in section 3.5 of this report

<sup>4</sup> EIRP = Output Power (dBm) + Antenna Gain (dBi)

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## Plots

922 MHz – Average Output Power



922 MHz – Average PSD



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### 3.3 – RF Conducted – Spurious Emissions/ Band Edges

<b>Manufacturer</b>	Vulture Systems, LLC
<b>Date</b>	10/12/2016
<b>Operator</b>	John Johnston
<b>Temp. / R.H.</b>	20 - 25° C / 30-60% R.H.
<b>Rule Part</b>	FCC 15.247 (d) / RSS-247 sect. 5.5
<b>Specific Measurement Procedure</b>	ANSI C63.10 Sections 11.11
<b>Additional Description of Measurement</b>	Peak output power measured in any 100 kHz band outside the authorized frequency band shall be attenuated by at least 30 dB relative to the in-band peak PSD level in 100 kHz (i.e., 30 dBc) if maximum conducted (average) output power was measured.
<b>Additional Notes</b>	1. Continuous modulated transmission used for this test. 2. Reference Level Plots were taken at the transmitted frequency and used to determine the 30 dBc limit line.

#### Reference Level Plot

922 MHz



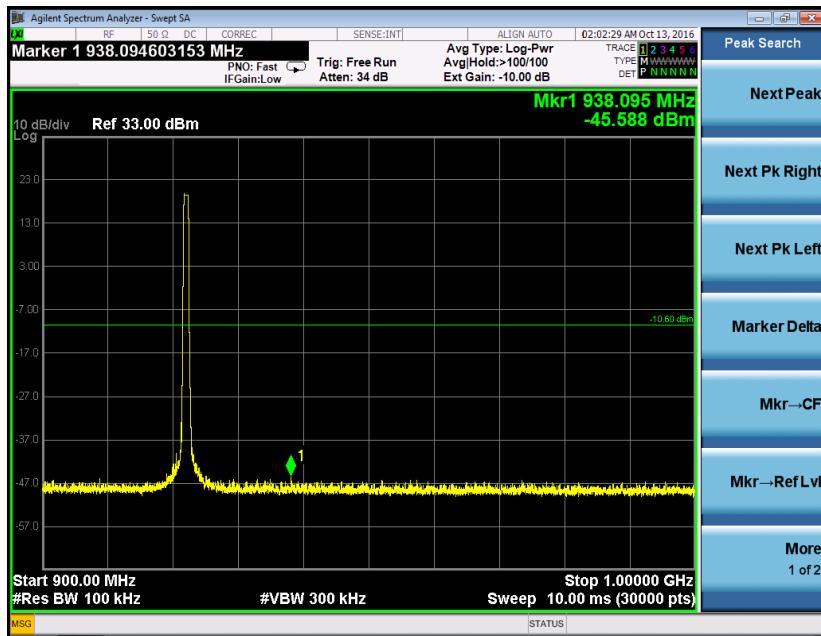
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## Plots

### 30 MHz – 900 MHz

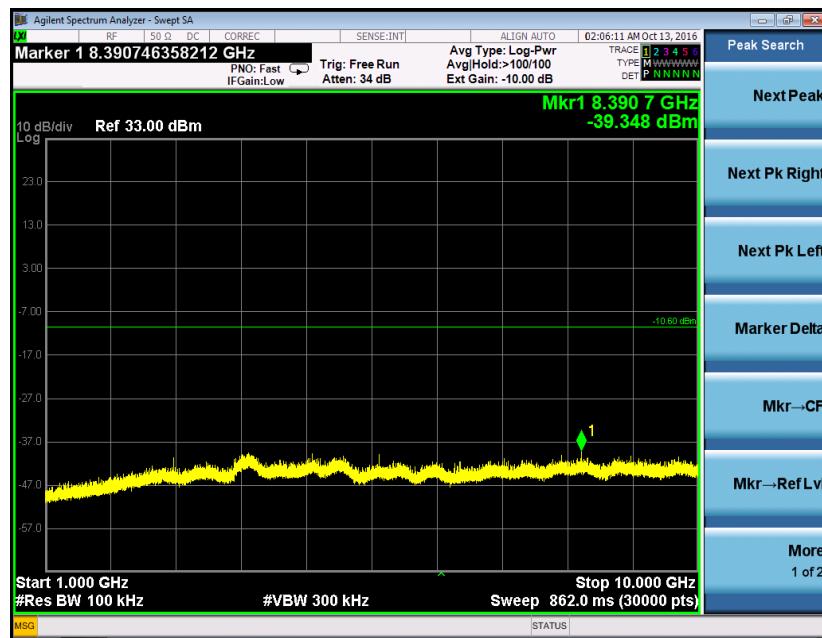


### 900 MHz – 1 GHz



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## 1-10 GHz

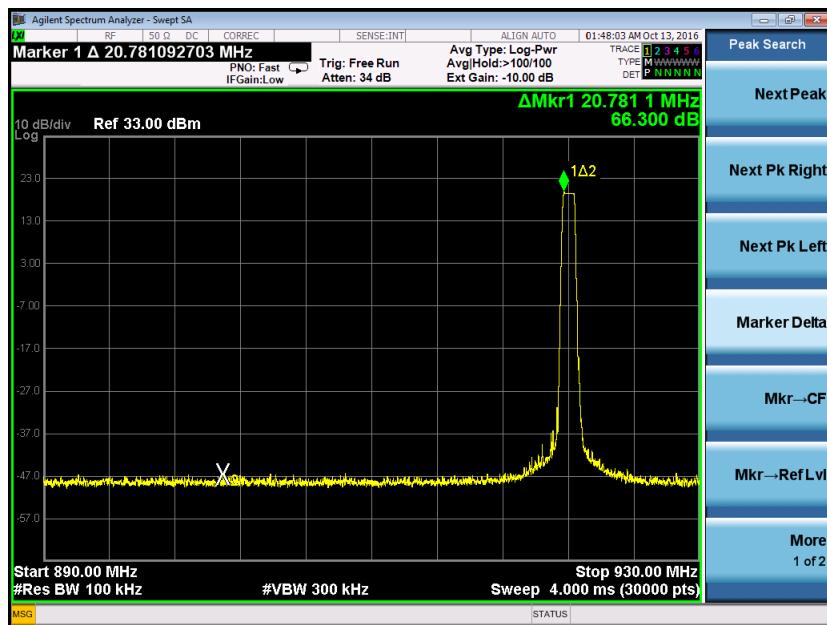


## 10-25 GHz

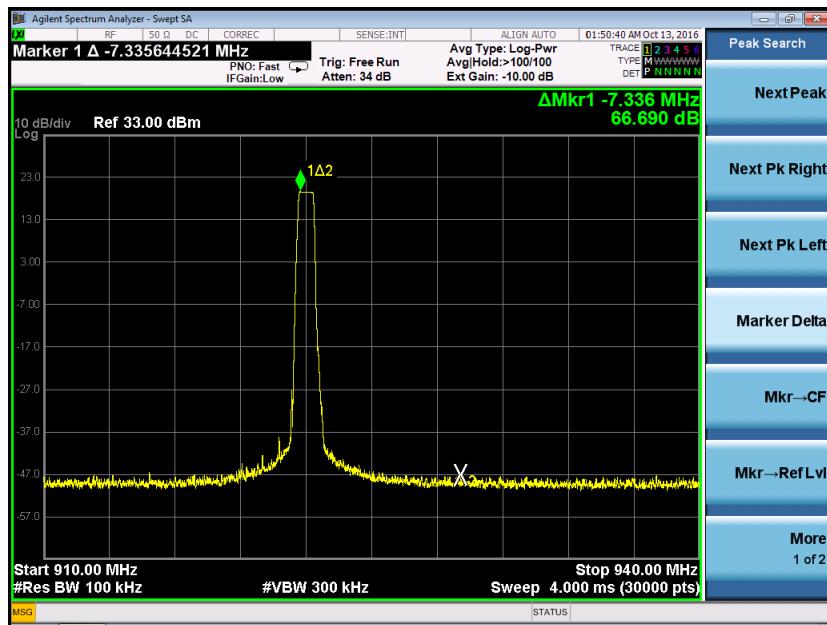


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## 922 MHz – Lower Band Edge



## 922 MHz – Upper Band Edge



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### 3.4 – RF Conducted – Frequency Stability

<b>Manufacturer</b>	Vulture Systems, LLC
<b>Date</b>	10/12/2016
<b>Operator</b>	John Johnston
<b>Temp. / R.H.</b>	20 - 25° C / 30-60% R.H.
<b>Rule Part</b>	FCC 15.247 and 2.1055 / RSS-247
<b>Specific Measurement Procedure</b>	ANSI C63.10 Section 6.8 ANSI C63.10 Section 5.13
<b>Additional Description of Measurement</b>	RF Conducted Measurement
<b>Additional Notes</b>	<ol style="list-style-type: none"> <li>Continuous unmodulated transmission used for this test (i.e., continuous wave mode).</li> <li>EUT Voltage Ratings – Nominal: 3.0 V; Minimum: 2.4 V; Maximum 3.5 V</li> <li>To perform testing, a variable DC supply was connected to the battery terminals of the VS1000</li> </ol>

The equations below illustrate how the limits and margin were calculated.

$$\text{Limit (Hz)} = \text{Channel Frequency (Hz)} / 10,000$$

$$\text{Margin (Hz)} = \text{Limit (Hz)} - |(\text{Channel Frequency (Hz)} - \text{Measured Frequency (Hz)})|$$

### Tables

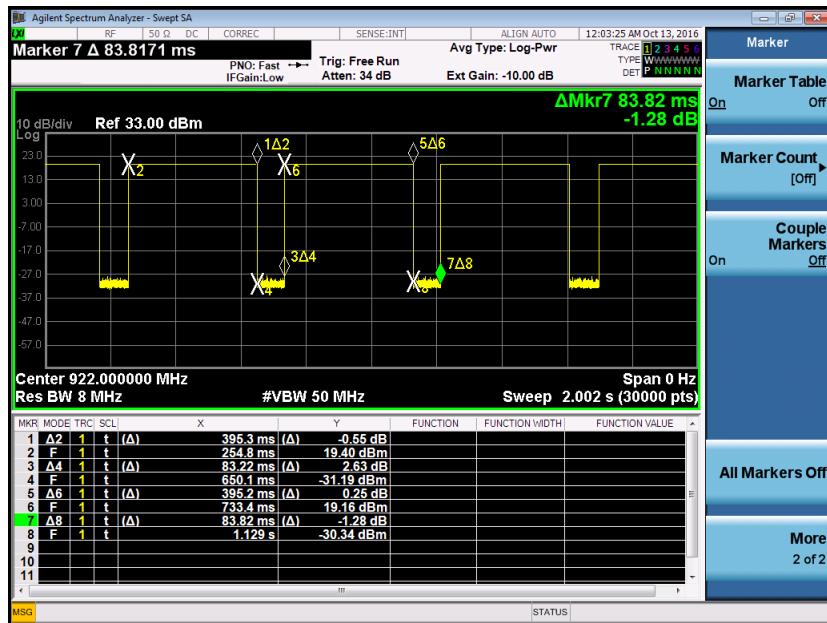
Frequency Stability $f = 922 \text{ MHz}$				
Supply Voltage (VDC)	Frequency (Hz)	Deviation		
		Hz	Limit (Hz)	Margin (Hz)
2.55	922000000	922001383	92200	90817
3.00	922000000	922001005	92200	91195
3.45	922000000	922000318	92200	91882

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### 3.5 – RF Conducted – Duty Cycle

<b>Manufacturer</b>	Vulture Systems, LLC
<b>Date</b>	10/12/2016
<b>Operator</b>	John Johnston
<b>Temp. / R.H.</b>	20 - 25° C / 30-60% R.H.
<b>Rule Part</b>	15.247 / RSS-247
<b>Specific Measurement Procedure</b>	ANSI C63.10 Section 11.6
<b>Additional Description of Measurement</b>	RF Conducted Measurement
<b>Additional Notes</b>	1. Continuous transmit modulated used for this test.

#### Plots



\*Note: Duty cycle is constant with variations less than +/- 2%

<b>Tx on time (ms)</b>	<b>Tx off time (ms)</b>	<b>Duty Cycle (%)</b>	<b>Duty Cycle Correction Factor (dB)</b>
395.3	83.22	82.6	0.830

**Duty Cycle Correction Factor = 10\*Log(1/Duty Cycle)**

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## 4.0 – Radiated Emissions

<b>Rule Part(s)</b>	FCC: 15.247 / 15.205 / 15.209 IC: RSS-247 / RSS-Gen		
<b>Measurement Procedure</b>	ANSI C63.10		
<b>Test Location</b>	LS Research, LLC - FCC Listed 3 meter Semi-Anechoic Chamber		
<b>Test Distance</b>	3 meters		
<b>EUT Placement</b>	Transmitter Mode: Below 1 GHz: 80 cm height Above 1 GHz: 150 cm height		
<b>Frequency Range of Measurement</b>	Biconical: 30-200 MHz	Log Periodic Dipole Array: 200-1000 MHz	Double-Ridged Waveguide Horn: 1-10 GHz
<b>Measurement Detectors</b>	30-800 MHz and 960-1000 MHz RBW: 120 kHz VBW: $\geq$ 300 kHz		1 – 10 GHz: RBW : 1 MHz VBW: 3 MHz (Transmitter Peak Measurements); 3 Hz (Transmitter Average Measurements) <sup>5</sup>
<b>Measurement Description</b>	<p>The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer before the measurements are performed. Data is gathered and reported as corrected values.</p> <p>The EUT is placed on a non-conductive pedestal <u>made of expanded polyethylene foam</u> centered on a turn-table in the test location with the antenna at a 3 meter separation distance from the EUT.</p> <p>Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.</p> <p>The EUT was tested in each of three orthogonal axis positions.</p>		
<b>Example Calculations</b>	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor(s) (when applicable)		

<sup>5</sup> Per ANSI C63.10 Section 4.1.4.2.3(f), the video bandwidth should be greater than  $[1/(\text{minimum transmitter on time})]$  and no less than 1 Hz.  $\{1/(395.3\text{ms}) = 2.529 \text{ Hz}\}$

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**FCC Part 15.209 / IC RSS-GEN sect 8.9 limits:**

Frequency (MHz)	3 m Limit ( $\mu\text{V/m}$ )	3 m Limit (dB $\mu\text{V/m}$ )	Detector Type
30-88	100	40.0	Quasi-Peak
88-216	150	43.5	Quasi-Peak
216-960	200	46.0	Quasi-Peak
Above 960	500	54.0	Quasi-Peak
Above 1 GHz	500	54.0	Average
Above 1 GHz	-	74.0	Peak

**4.1 – Transmitter Radiated Spurious Emissions in Restricted Bands**

<b>Manufacturer</b>	Vulture Systems LLC		
<b>Date</b>	10/13/2016, 10/18/2016, and 10/19/2016		
<b>Operator</b>	John Johnston		
<b>Temp. / R.H.</b>	20 - 25° C / 30-60% R.H.		
<b>Rule Part</b>	15.247 / 15.205 / 15.209 / RSS-247 / RSS-Gen		
<b>Measurement Procedure</b>	ANSI C63.10 - 2013 Sections 6.3, 6.5, 6.6, and 11.12.1		
<b>Test Distance</b>	3 meters		
<b>EUT Placement</b>	Below 1 GHz: EUT situated on 80 cm table Above 1 GHz: EUT situated on 150 cm table		
<b>Detectors Above 1 GHz</b>	Quasi-Peak: RBW: 120 kHz VBW: $\geq$ 300 kHz	Peak: RBW = 1 MHz VBW $\geq$ 3 MHz	Average: RBW = 1 MHz VBW = 3 Hz
<b>Additional Notes</b>	<ol style="list-style-type: none"> <li>1) Tested in continuous transmit modulated mode in three orientations.</li> <li>2) EUT maximized in azimuth and antenna height with maximum results reported.</li> <li>3) Video bandwidth greater than [1/(minimum transmitter on time)]. Thus, a 3 Hz video bandwidth was used for average measurements.</li> </ol>		

**Example Calculation:**

FCC 15.209 Quasi-Peak Limit @ 3 meter (dB $\mu\text{V/m}$ ) – Quasi-Peak Reading (dB $\mu\text{V/m}$ ) = Margin

FCC 15.209 Average Limit @ 3 meter (dB $\mu\text{V/m}$ ) – Average Reading (dB $\mu\text{V/m}$ ) = Margin

FCC 15.209 Peak Limit @ 3 meter (dB $\mu\text{V/m}$ ) – Peak Reading (dB $\mu\text{V/m}$ ) = Margin

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## Tables

### Below 1 GHz

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dB $\mu$ V/m)	FCC Quasi Peak Limit(dB $\mu$ V/m)	Margin (dB)	Antenna Polarity	EUT Orientation
198.00	1.00	0	24.80	43.50	18.70	H	F
199.40	1.00	0	24.70	43.50	18.80	V	F
776.81	1.00	0	27.80	46.00	18.20	V	F
790.15	1.00	0	28.10	46.00	17.90	H	F
987.63	1.00	0	29.10	54.00	24.90	H	F
963.09	1.00	0	29.20	54.00	24.80	V	F

**Note: No emissions were detected between 30-1000 MHz. The measurements provided above are noise floor measurements.**

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## Above 1 GHz

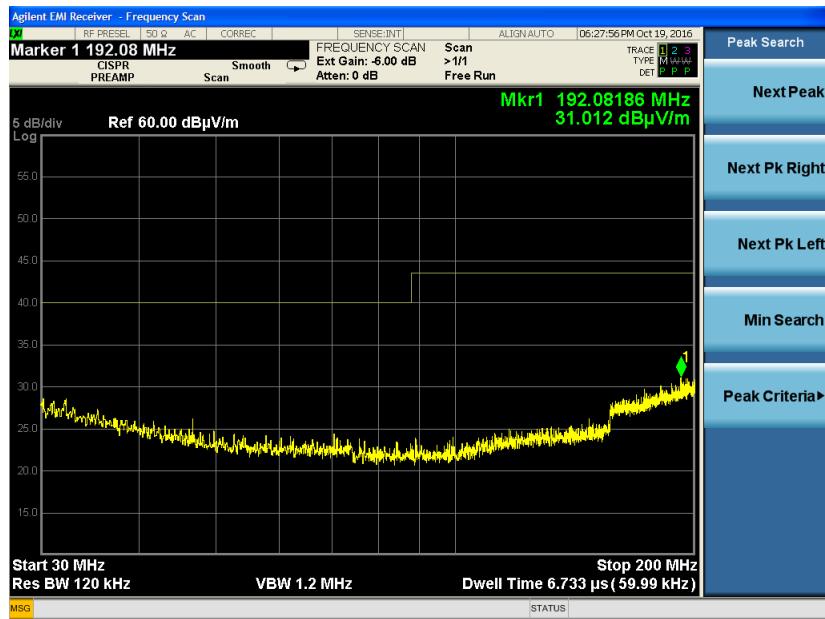
Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBuV/m)	Average Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Antenna Polarization	EUT Orientation
2766	2.50	18	51.79	47.33	54	6.67	H	V
3688	2.58	26	53.86	47.57	54	6.44	H	V
4610	2.66	51	55.29	47.32	54	6.68	H	V
7376	2.20	52	64.55	53.68	54	0.32	H	V
8298	2.10	45	61.53	49.60	54	4.40	H	V
2766	1.90	0	54.85	50.67	54	3.33	V	V
3688	2.60	0	55.72	49.83	54	4.17	V	V
4610	2.60	0	55.29	47.40	54	6.61	V	V
7376	1.75	0	52.37	40.97	54	13.03	V	V
8298	1.71	340	51.81	39.78	54	14.22	V	V
2766	1.25	28	54.69	50.55	54	3.45	H	H
3688	1.00	26	55.25	49.09	54	4.91	H	H
4610	1.00	16.25	54.93	46.78	54	7.22	H	H
7376	4.00	250	59.55	46.64	54	7.36	H	H
8298	3.69	55	55.06	43.06	54	10.94	H	H
2766	1.30	11	51.11	46.48	54	7.52	V	H
3688	1.00	0	52.09	45.54	54	8.46	V	H
4610	1.09	334	52.25	43.86	54	10.14	V	H
7376	2.71	21	63.67	52.58	54	1.42	V	H
8298	2.50	26	59.68	47.91	54	6.09	V	H
2766	3.83	241	52.13	47.76	54	6.25	H	F
3688	4.00	50	51.74	45.30	54	8.70	H	F
4610	3.69	51	51.22	42.72	54	11.28	H	F
7376	3.20	1.71	60.99	50.01	54	3.99	H	F
8298	3.96	164	56.11	44.04	54	9.96	H	F
2766	3.37	145	53.35	49.16	54	4.84	V	F
3688	3.44	136	54.70	48.54	54	5.46	V	F
4610	3.22	132	54.30	46.05	54	7.95	V	F
7376	3.10	99	62.66	51.72	54	2.28	V	F
8298	2.86	110	58.72	46.79	54	7.21	V	F

**Note: Radiated emissions at 1844 MHz, 5532 MHz, 6454 MHz, and 9220 MHz shown in the screen captures below are located within unrestricted bands.**

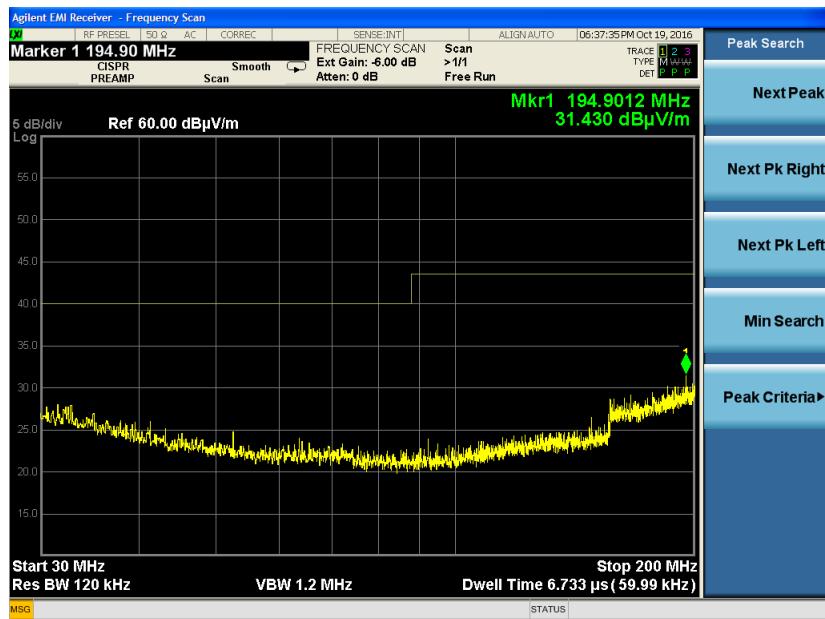
Prepared For: Vulture Systems, LLC	Name: VS1000
Report: TR 316280	Model: VS1000
LSR: C-2557	Serial: 001/002

## Plots<sup>6</sup>

### 30 MHz – 200 MHz, Horizontal Polarization



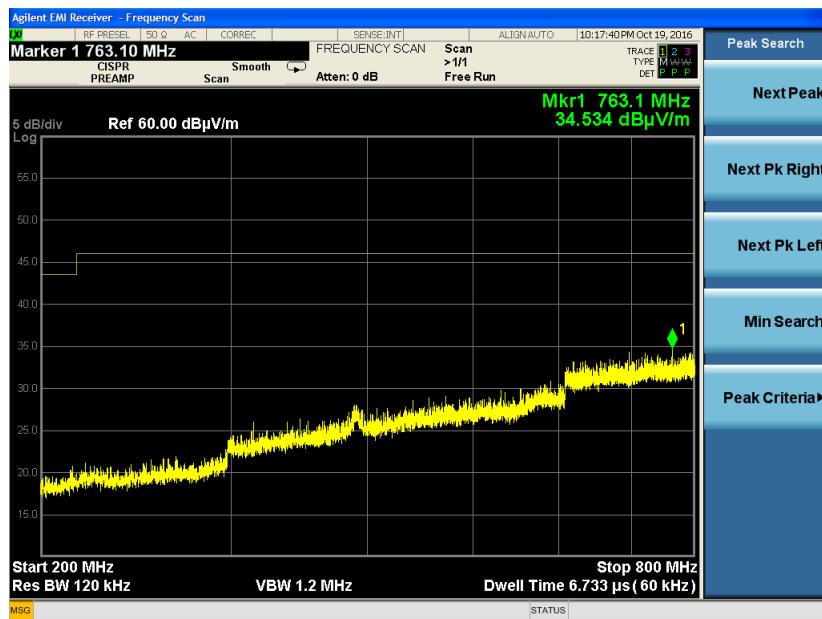
### 30 MHz – 200 MHz, Vertical Polarization



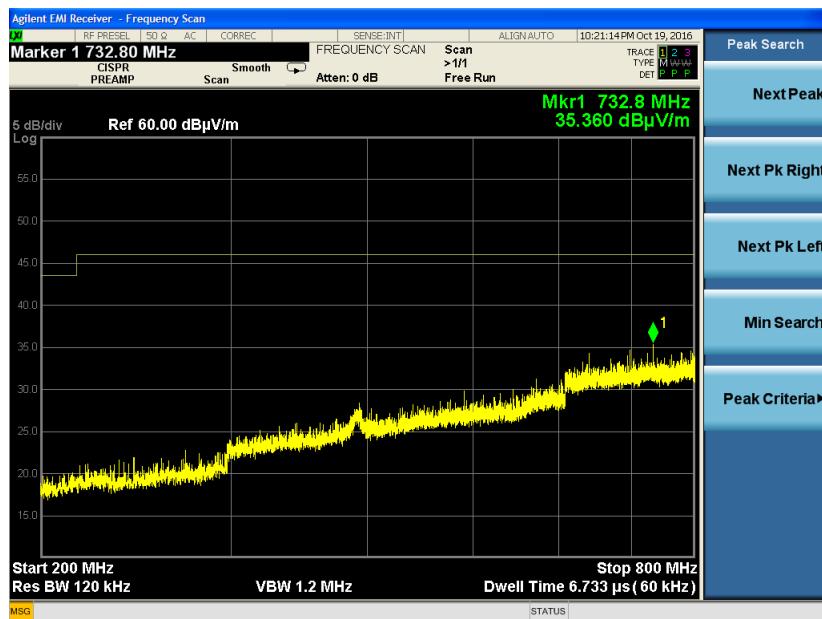
<sup>6</sup> The worst case traces across all EUT orientations are provided in the screen captures below

Prepared For: Vulture Systems, LLC	Name: VS1000
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## 200 MHz – 800 MHz, Horizontal Polarization



## 200 MHz – 800 MHz, Vertical Polarization



Prepared For: Vulture Systems, LLC	Name: VS1000
Report: TR 316280	Model: VS1000
LSR: C-2557	Serial: 001/002

## 960 MHz – 1000 MHz, Horizontal Polarization

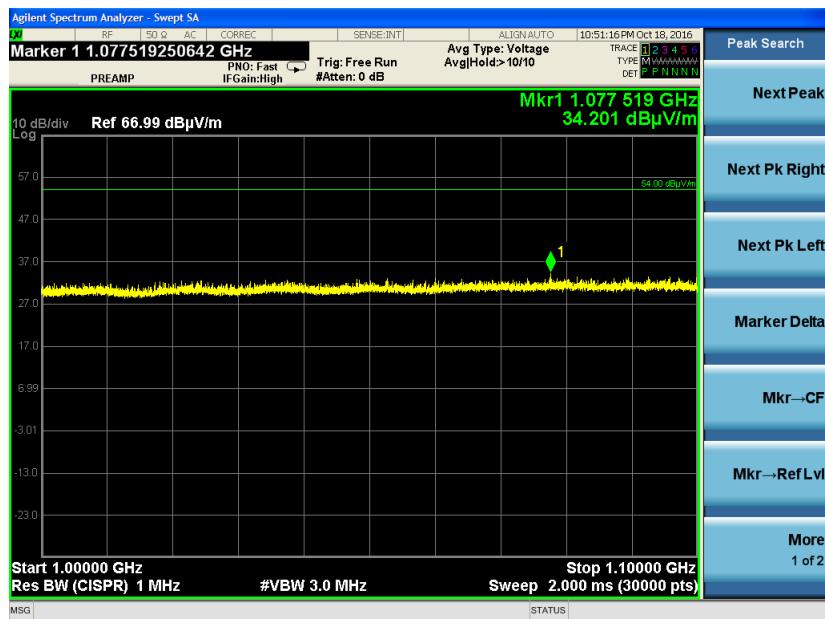


## 960 MHz – 1000 MHz, Vertical Polarization

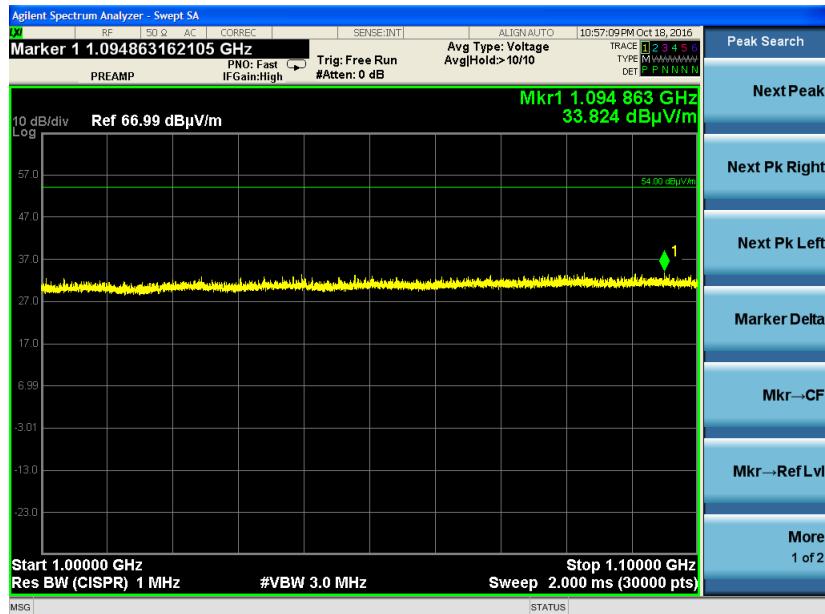


Prepared For: Vulture Systems, LLC	Name: VS1000
Report: TR 316280	Model: VS1000
LSR: C-2557	Serial: 001/002

## 1000 MHz – 1100 MHz, Horizontal Polarization

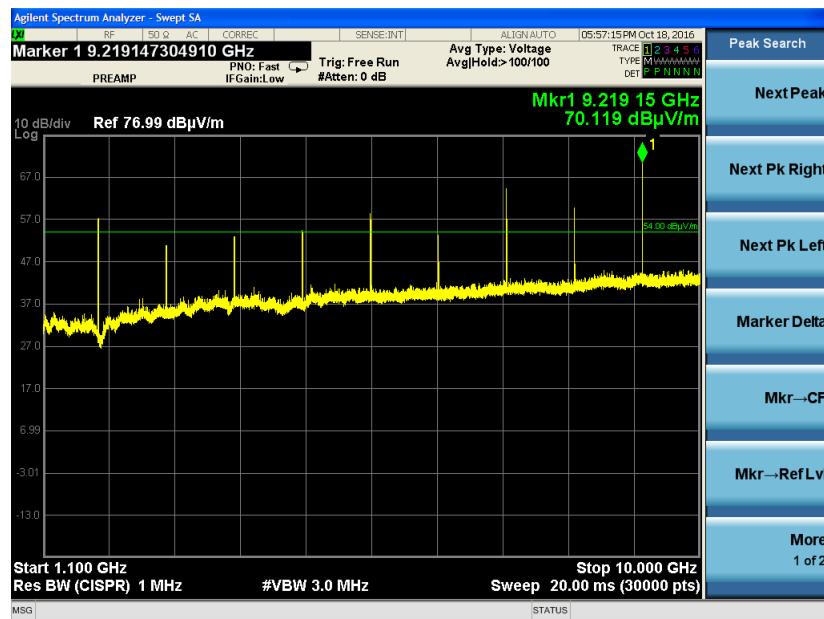


## 1000 MHz – 1100 MHz, Vertical Polarization



Prepared For: Vulture Systems, LLC	Name: VS1000
Report: TR 316280	Model: VS1000
LSR: C-2557	Serial: 001/002

## 1100 MHz – 10000 MHz, Horizontal Polarization



## 1100 MHz – 10000 MHz, Vertical Polarization



Prepared For: Vulture Systems, LLC	Name: VS1000
Report: TR 316280	Model: VS1000
LSR: C-2557	Serial: 001/002

## Appendix A – Test Equipment



Date : 18-Oct-2016

Type Test : Tx Radiated Emissions

Job #: C-2557

Prepared By: John Johnston

Customer: Vulture Systems

Quote #: 316280

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960171	Cable - low loss 1m	A.H. Systems, Inc.	SAC-26G-6	386	3/31/2016	3/31/2017	Active Calibration
2	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	7/22/2016	7/22/2017	Active Calibration
3	EE 960160	0.8-21GHz LNA	Mini-Circuits	ZVA-213X-S+	977711030	7/22/2016	7/22/2017	Active Calibration
4	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
5	AA 960156	900MHz High Pass Filter	KWM	HPP-L-14185	unknown	7/25/2016	7/25/2017	Active Calibration
6	AA 960150	Biconical Antenna	ETS	3110B	0003-3346	2/1/2016	2/1/2017	Active Calibration
7	AA 960163	Log Periodic Antenna	A.H. Systems, Inc.	SAS-512-2	500	3/18/2016	3/18/2017	Active Calibration

Project Engineer:

Quality Assurance:



a Laird Business

Date : 14-Nov-2016

Type Test : Conducted Measurements

Job #: C-2557

Prepared By: John Johnston

Customer: Vulture Systems

Quote #: 316280

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	44GHz EXA Spectrum Analyzer	Agilent	N9010A	MY53400296	12/18/2015	12/18/2016	Active Calibration
2	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	Verification	Verification	System

Project Engineer:

Quality Assurance:

Prepared For: Vulture Systems, LLC	Name: VS1000
Report: TR 316280	Model: VS1000
LSR: C-2557	Serial: 001/002

## Appendix B - Uncertainty Summary

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of  $k = 2$ .

Measurement Type	Configuration	Uncertainty Values
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	AMN	3.4 dB
Telecom Conducted Emissions	AAN	4.9 dB
Disturbance Power (Emissions)	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/Meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst / Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

Parameter	ETSI U.C.+/-	U.C.+/-
Radio Frequency, from F0	$1 \times 10^{-7}$	$0.55 \times 10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (PM)	1.5 dB	1.2 dB
RF conducted emissions (SA)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

Prepared For: Vulture Systems, LLC	Name: VS1000
Report: TR 316280	Model: VS1000
LSR: C-2557	Serial: 001/002

## Appendix C - References

Publication	Year	Title
FCC CFR Parts 0-15	2016	Code of Federal Regulations – Telecommunications
ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
RSS-247 Issue 1	2015	Digital Transmission System (DTSS), Frequency Hopping System (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus

Prepared For: Vulture Systems, LLC	Name: VS1000
Report: TR 316280	Model: VS1000
LSR: C-2557	Serial: 001/002