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ENGINEERING TEST REPORT #: 316243
LSR JOB #: C-2558

Compliance Testing of:

VS2000

Test Date(s):

10/12/2016	10/14/2016	10/18/2016
10/13/2016	10/17/2016	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:

Khairul Aidi Zainal, Engineering Manager-Test Services.

Signature: 

Date: 11/7/2016

Project Engineer:

John Johnston, EMC Engineer I

Signature:  Date: 10/20/16

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Report: TR 316243	Model: VS2000
LSR: C-2558	Serial: 001/002

LS Research, LLC in Review

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



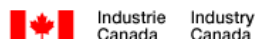
A2LA – American Association for Laboratory Accreditation

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



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*



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*

Prepared For: Vulture Systems, LLC	Name: VS2000
Report: TR 316243	Model: VS2000
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Summary of Test Report

Between October 12, 2016 and October 19, 2016 the VS2000, provided by Vulture Systems LLC, was tested and MEETS the following requirements:

FCC and IC Paragraph	Test Requirements	Compliance (Yes/No)
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 ¹

1 – AC Line conducted emission testing not required for battery operated devices.

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.

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1.0 Client Information

Manufacturer Name:	Vulture Systems, LLC
Address:	1764 Koshkonong Rd
Contact Person:	Gregg Haensgen

1.1 Equipment Under Test (EUT) Information

Product Name:	VS2000
Model Number:	VS2000
Serial Number:	001/002

1.2 Product Information

The VS2000 is a base transceiver designed to report to handheld units (i.e., VS1000) in a VultureNet system. The VS2000 is powered by two AA batteries in series that present a 3.0 V nominal voltage to the board. The VS2000 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.

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1.5 Additional Information

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

Test operational modes (transmit, receive, continuous wave) were instantiated by selecting a switch combination on a four position DIP switch onboard the EUT. Firmware version 7.0.0 was implemented on the VS2000.

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.

Frequency Range	Resolution Bandwidth
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)	0.113 W
Conducted Output Power, Average	18.542 dBm
DTS Occupied Bandwidth (-6 dB)	0.776 MHz
99% Bandwidth	0.620 MHz
Type of Modulation	Chirp Spread Spectrum
Emission Designator	620KX1D
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Transmitter Spurious (worst case) at 3 meters	52.254 dB μ V/m (at 2766 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

Manufacturer	Vulture Systems, LLC
Test Location	LS Research, LLC
Rule Part	FCC Part 15.247 / RSS-247
General Measurement Procedure	ANSI C63.10-2013
General Description of Measurement	<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

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

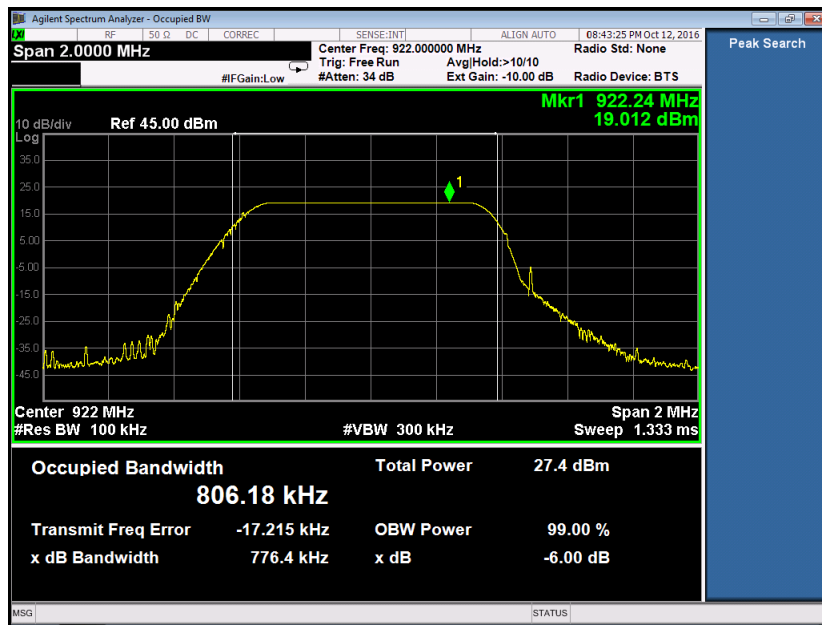
Table

Frequency (MHz)	DTS (6 dB) Bandwidth (MHz)	DTS (6 dB) Bandwidth Minimum Limit (MHz)	99% Bandwidth (MHz)	20 dB Bandwidth (MHz)
922	0.776	0.500	0.620	0.696

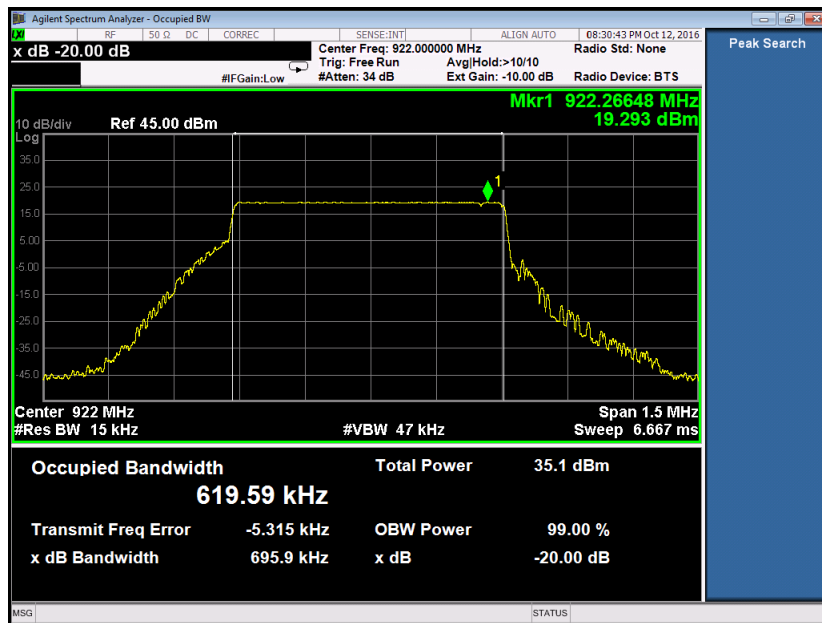
Prepared For: Vulture Systems, LLC	Name: VS2000
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Plots

922 MHz – DTS (-6dB) BW



922 MHz – 99% and 20 dB BW



Prepared For: Vulture Systems, LLC	Name: VS2000
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3.2 – RF Conducted – Fundamental Power and Spectral Density

Manufacturer	Vulture Systems, LLC
Date	10/19/2016
Operator	Kimberly Bay
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247(b)(3)/ FCC 15.247(e) / RSS-247 Section 5.4(3)/ RSS-247 Section 5.2(2)
Specific Measurement Procedure¹	ANSI C63.10 Section 11.9.2.2.4 (Method AVGSA-2) ANSI C63.10 Section 11.10.5 (Method AVGPS-2)
Additional Description of Measurement	Average Output Power and Average PSD methods utilized for measurement 10 kHz resolution bandwidth used for Peak Power Spectral Density measurement
Additional Notes	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 ² (dB)	Corrected Max Average Conducted Output Power (dBm)	Power Limit (dBm)	Output Power Margin (dB)	EIRP (dBm) ³	EIRP Limit (dBm)	EIRP Margin (dB)
922	16.924	1.618	18.542	30	11.458	20.542	36	15.458

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

Frequency (MHz)	Max Average PSD (dBm)	Duty Cycle Correction ³ (dB)	Corrected Max Average PSD (dBm)	PSD Limit in 3 kHz RBW (dBm)	Margin (dB)
922	3.815	1.618	5.433	8	2.567

Corrected Average PSD = Average PSD + Duty Cycle Correction

¹ The test methods used were based on duty cycle measurements provided in section 3.5 of this report

² The duty cycle correction factor is derived using an equation provided in section 3.5 of this report

³ EIRP = Output Power (dBm) + Antenna Gain (dBi)

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Plots

922 MHz – Average Output Power



922 MHz – Average PSD



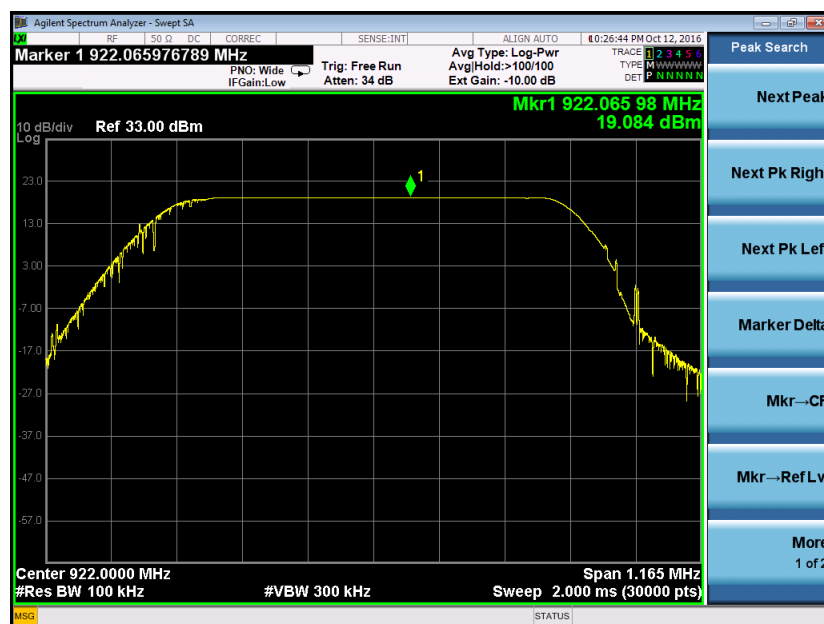
Prepared For: Vulture Systems, LLC	Name: VS2000
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3.3 – RF Conducted – Spurious Emissions/ Band Edges

Manufacturer	Vulture Systems, LLC
Date	10/12/2016
Operator	John Johnston
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247 (d) / RSS-247 sect. 5.5
Specific Measurement Procedure	ANSI C63.10 Sections 11.11
Additional Description of Measurement	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.
Additional Notes	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

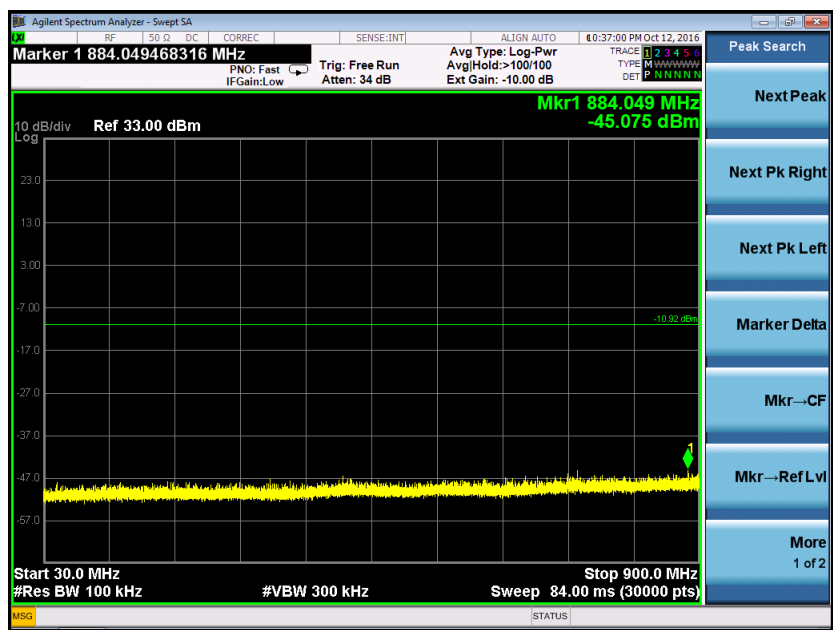
922 MHz



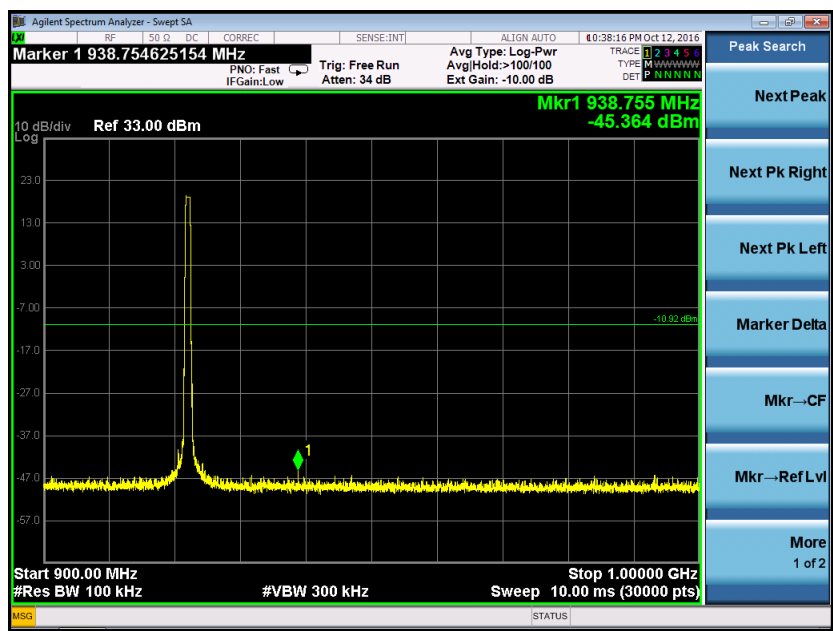
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Plots

30 MHz – 900 MHz

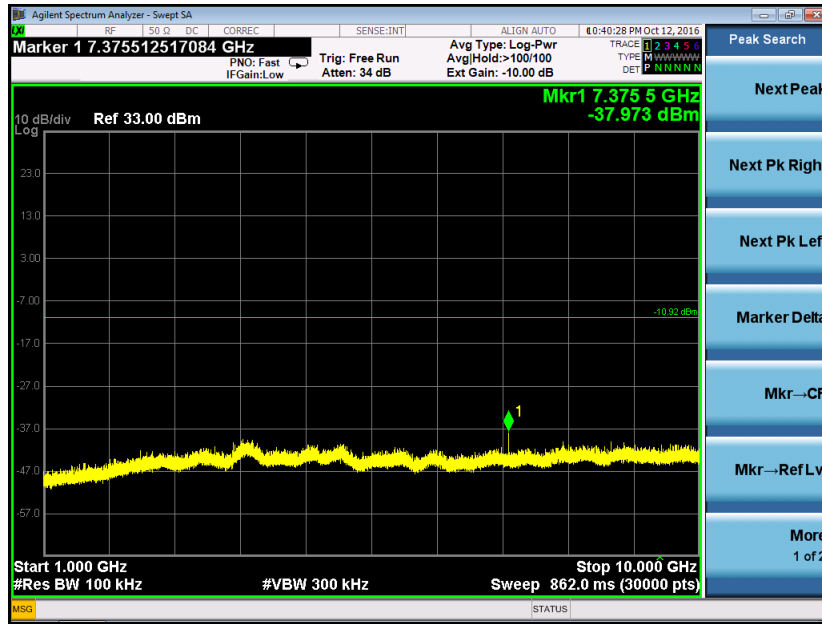


900 MHz – 1 GHz



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1-10 GHz

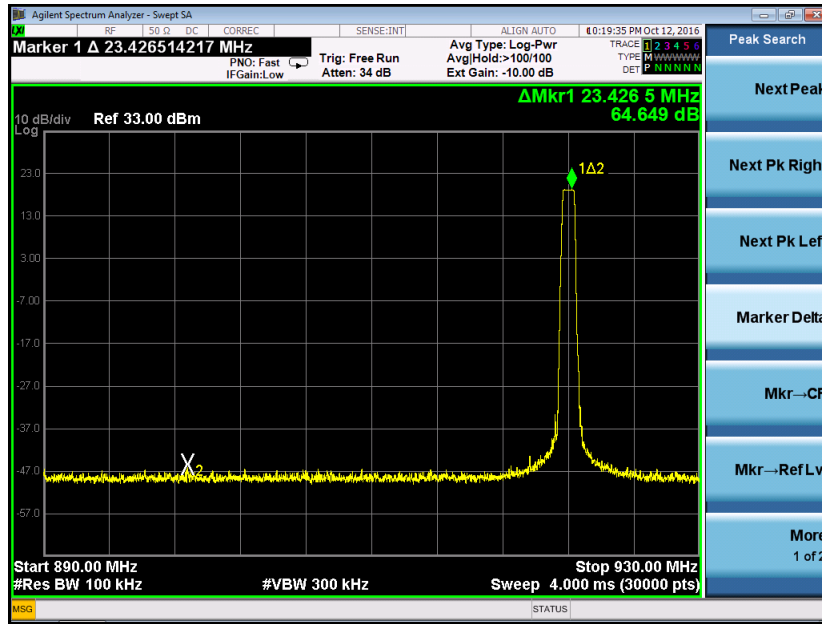


10-25 GHz

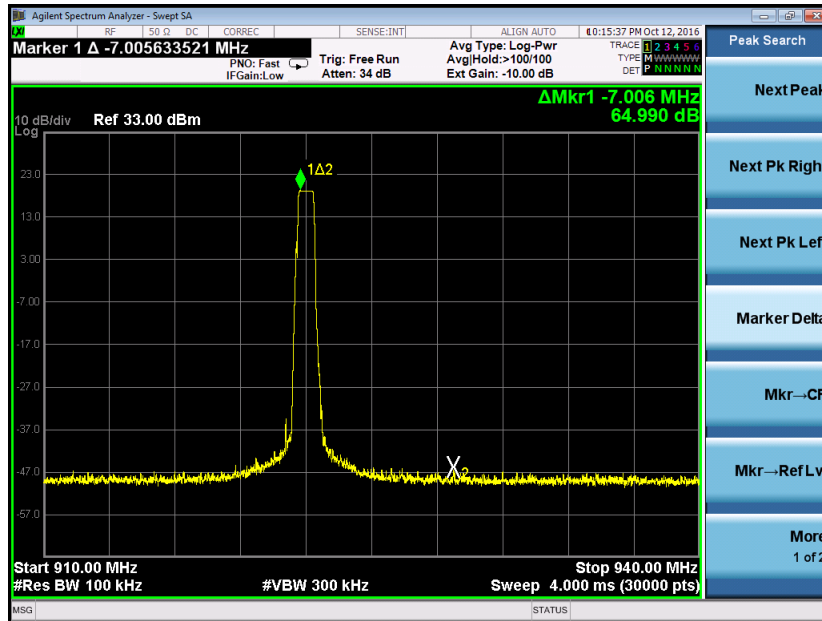


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922 MHz – Lower Band Edge



922 MHz – Upper Band Edge



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3.4 – RF Conducted – Frequency Stability

Manufacturer	Vulture Systems, LLC
Date	10/12/2016
Operator	John Johnston
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Rule Part	FCC 15.247 and 2.1055 / RSS-247
Specific Measurement Procedure	ANSI C63.10 Section 6.8 ANSI C63.10 Section 5.13
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	<ol style="list-style-type: none"> 1. Continuous unmodulated transmission used for this test (i.e., continuous wave mode). 2. EUT Voltage Ratings – Nominal: 3.0 V; Minimum: 2.4 V; Maximum 3.5 V 3. To perform testing, a variable DC supply was connected to the battery terminals of the VS2000

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

Limit (Hz) = Channel Frequency (Hz)/10,000

Margin (Hz) = Limit (Hz) - | (Channel Frequency (Hz) – Measured Frequency (Hz) |

Tables

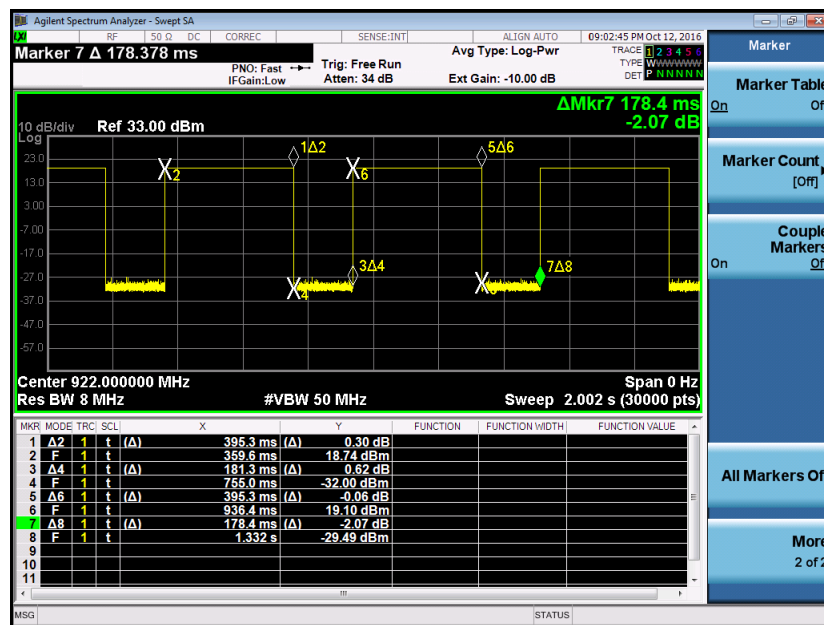
Frequency Stability f = 922 MHz				
Supply Voltage (VDC)	Frequency (Hz)	Deviation		
		Hz	Limit (Hz)	Margin (Hz)
2.55	922000000	921997893	92200	90093
3.00	922000000	921997049	92200	89249
3.45	922000000	921997201	92200	89401

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3.5 – RF Conducted – Duty Cycle

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

Plots



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

Tx on time (ms)	Tx off time (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
395.3	178.4	68.904	1.618

Duty Cycle Correction Factor = $10 \cdot \text{LOG}(1/\text{Duty Cycle})$

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4.0 – Radiated Emissions

Rule Part(s)	FCC: 15.247 / 15.205 / 15.209 IC: RSS-247 / RSS-Gen		
Measurement Procedure	ANSI C63.10		
Test Location	LS Research, LLC - FCC Listed 3 meter Semi-Anechoic Chamber		
Test Distance	3 meters		
EUT Placement	Transmitter Mode: Below 1 GHz: 80 cm height Above 1 GHz: 150 cm height		
Frequency Range of Measurement	Biconical: 30-200 MHz	Log Periodic Dipole Array: 200-1000 MHz	Double-Ridged Waveguide Horn: 1-10 GHz
Measurement Detectors	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) ⁴
Measurement Description	<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>		
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor(s) (when applicable)		

⁴ 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 (μV/m)	3 m Limit (dBμV/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

Sample conversion of field strength (μ V/m to dB μ V/m):

$$\text{dB}\mu\text{V/m} = 20 \log_{10} (100) = 40 \text{ dB}\mu\text{V/m (from 30-88 MHz)}$$

Reported data is the raw data corrected for all applicable factors such as antenna factors, cable loss, etc.

Sample reported data for 200MHz:

Raw Data + Antenna Factor + Cable Factor = Reported Data

$$18.2 \text{ dB}\mu\text{V/m} + 15.8 \text{ dB} + 1.45 \text{ dB} = 35.45 \text{ dB}\mu\text{V/m}$$

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4.1 – Transmitter Radiated Spurious Emissions in Restricted Bands

Manufacturer	Vulture Systems LLC		
Date	10/13/2016, 10/14/2016, 10/17/2016, and 10/19/2016		
Operator	John Johnston		
Temp. / R.H.	20 - 25° C / 30-60% R.H.		
Rule Part	15.247/ 15.205 / 15.209/ RSS-247 / RSS-Gen		
Measurement Procedure	ANSI C63.10 - 2013 Sections 6.3, 6.5, 6.6, and 11.12.1		
Test Distance	3 meters		
EUT Placement	Below 1 GHz: EUT situated on 80 cm table Above 1 GHz: EUT situated on 150 cm table		
Detectors Above 1 GHz	Quasi-Peak: RBW: 120 kHz VBW: ≥ 300 kHz	Peak: RBW = 1 MHz VBW ≥ 3 MHz	Average: RBW = 1 MHz VBW = 3 Hz
Additional Notes	1) Tested in continuous transmit modulated mode in three orientations. 2) EUT maximized in azimuth and antenna height with maximum results reported. 3) Video bandwidth greater than $[1/(\text{minimum transmitter on time})]$. Thus, a 3 Hz video bandwidth was used for average measurements.		

Example Calculation:

FCC 15.209 Quasi-Peak Limit @ 3 meter (dB μ V/m) – Quasi-Peak Reading (dB μ V/m) = Margin

FCC 15.209 Average Limit @ 3 meter (dB μ V/m) – Average Reading (dB μ V/m) = Margin

FCC 15.209 Peak Limit @ 3 meter (dB μ V/m) – Peak Reading (dB μ V/m) = Margin

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Tables

Below 1 GHz

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBμV/m)	Quasi Peak Limit (dBμV/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

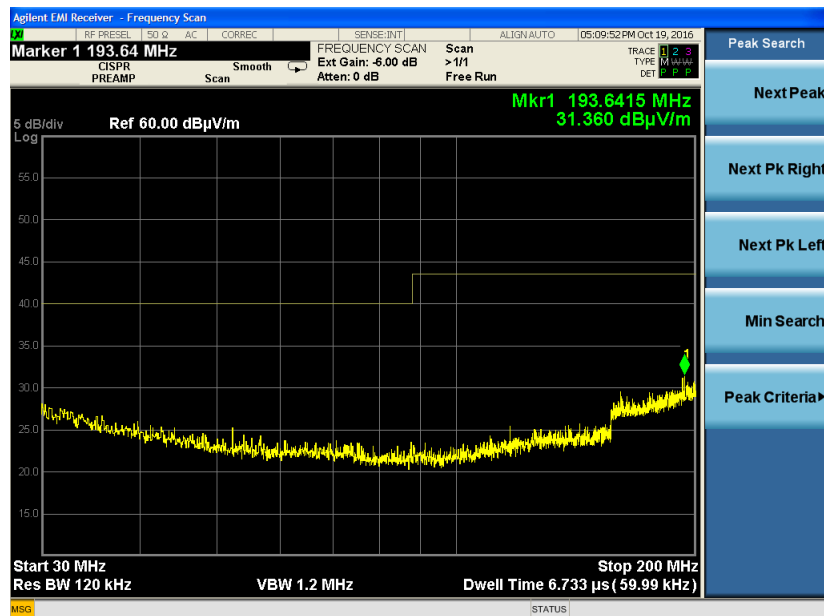
Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBμV/m)	Average Reading (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)	Antenna Polarization	EUT Orientation
2766	1.00	211	53.386	49.055	54	4.945	H	V
3688	3.00	167	56.048	49.917	54	4.083	H	V
4610	2.11	155	50.959	43.549	54	10.451	H	V
7376	1.68	115	55.403	44.214	54	9.786	H	V
8298	1.85	150	54.519	42.768	54	11.232	H	V
2766	1.99	232	52.68	48.262	54	5.738	V	V
3688	1.40	255	49.164	41.935	54	12.065	V	V
4610	2.00	200	46.629	38.195	54	15.805	V	V
7376	1.87	170	56.871	45.75	54	8.25	V	V
8298	2.00	175	55.293	43.624	54	10.376	V	V
2766	1.40	221	52.423	47.884	54	6.116	H	H
3688	1.00	121	50.013	42.663	54	11.337	H	H
4610	2.07	300	47.635	39.56	54	14.44	H	H
7376	2.40	168	56.937	45.85	54	8.15	H	H
8298	2.50	150	56.672	44.844	54	9.156	H	H
2766	1.37	301	56.152	52.187	54	1.813	V	H
3688	1.00	145	56.062	49.907	54	4.093	V	H
4610	1.00	181	50.508	42.876	54	11.124	V	H
7376	4.00	147.5	55.394	44.39	54	9.61	V	H
8298	1.00	134	50.048	37.938	54	16.062	V	H
2766	1.68	174	56.246	52.254	54	1.746	H	F
3688	3.35	112	54.498	48.057	54	5.943	H	F
4610	2.55	60.5	48.972	40.686	54	13.314	H	F
7376	2.93	88.5	52.249	40.972	54	13.028	H	F
8298	1.00	315	49.235	36.967	54	17.033	H	F
2766	1.73	48	51.493	47.042	54	6.958	V	F
3688	1.00	199	51.904	44.924	54	9.076	V	F
4610	2.33	6.5	49.109	41.388	54	12.612	V	F
7376	3.01	95	55.972	44.737	54	9.263	V	F
8298	2.48	100	53.495	41.809	54	12.191	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 and were not measured.

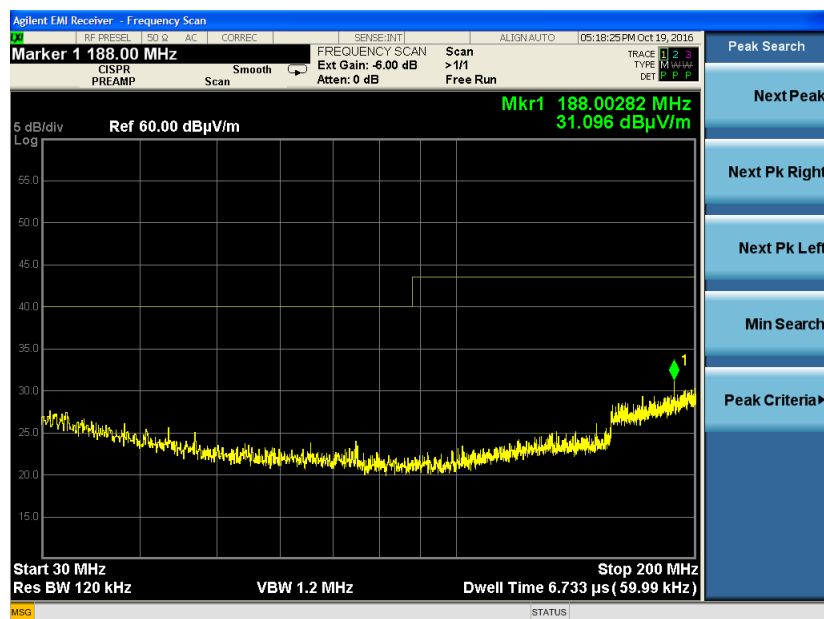
Prepared For: Vulture Systems, LLC	Name: VS2000
Report: TR 316243	Model: VS2000
LSR: C-2558	Serial: 001/002

Plots⁵

30 MHz – 200 MHz, Horizontal Polarization



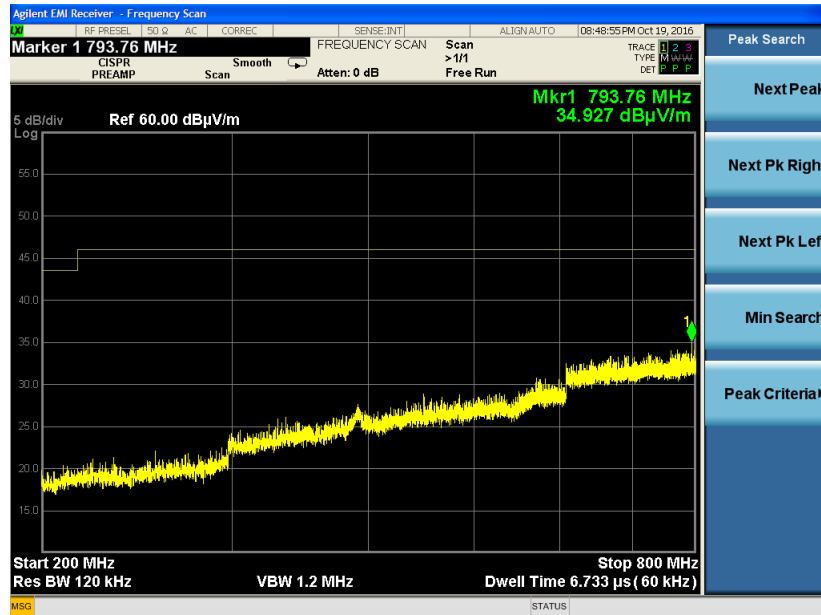
30 MHz – 200 MHz, Vertical Polarization



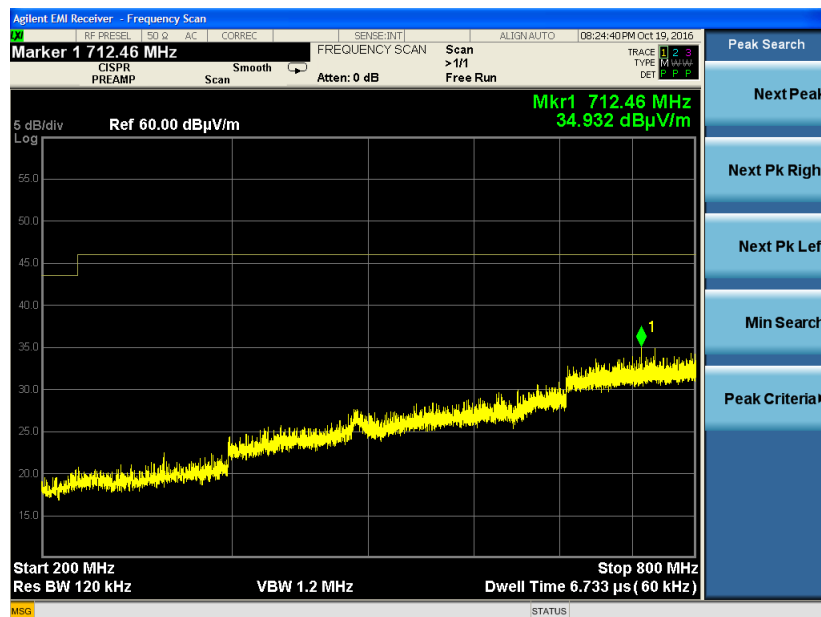
⁵ The worst case traces across all EUT orientations are provided in the screen captures below

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200 MHz – 800 MHz, Horizontal Polarization

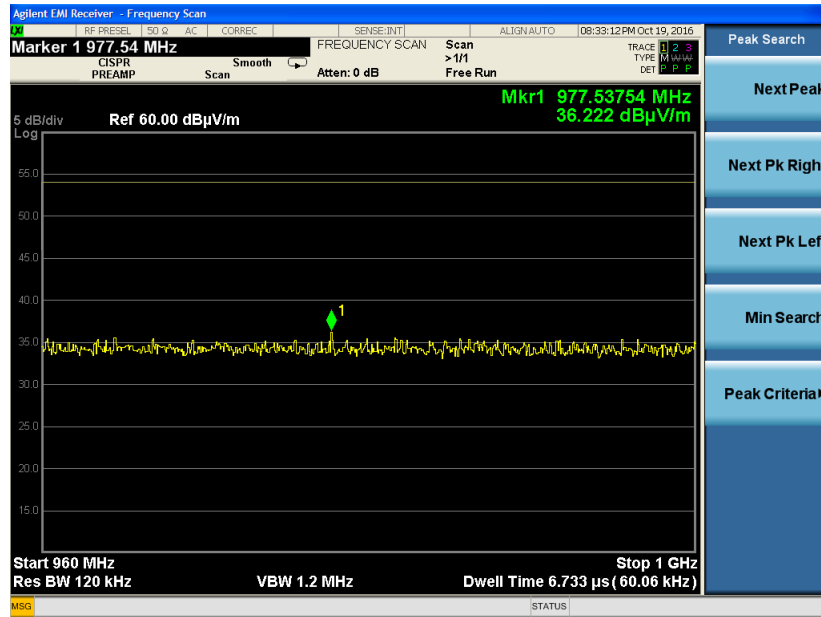


200 MHz – 800 MHz, Vertical Polarization



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960 MHz – 1000 MHz, Horizontal Polarization

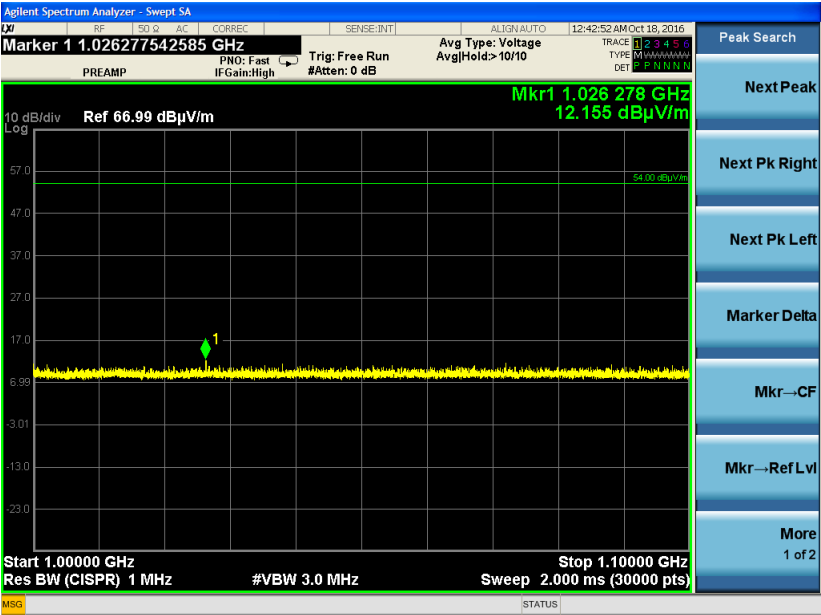


960 MHz – 1000 MHz, Vertical Polarization

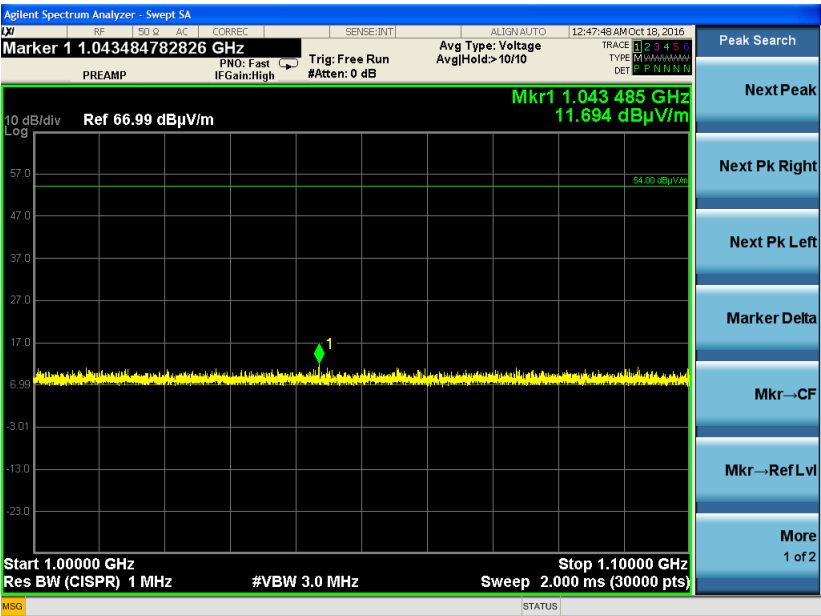


Prepared For: Vulture Systems, LLC	Name: VS2000
Report: TR 316243	Model: VS2000
LSR: C-2558	Serial: 001/002

1000 MHz – 1100 MHz, Horizontal Polarization

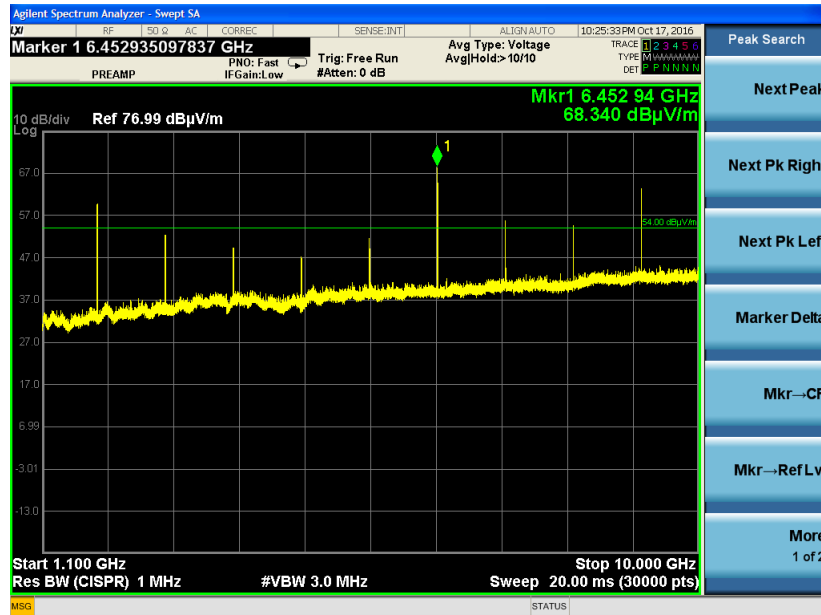


1000 MHz – 1100 MHz, Vertical Polarization

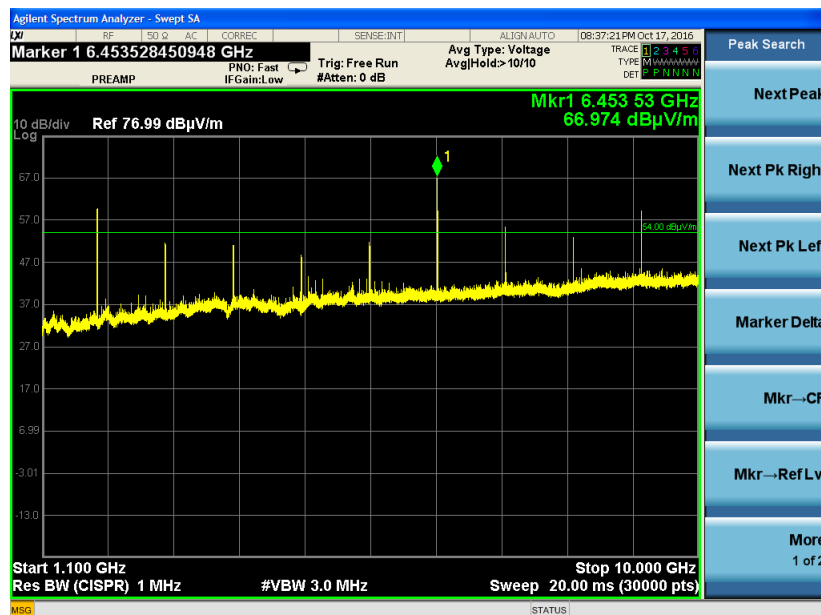


Prepared For: Vulture Systems, LLC	Name: VS2000
Report: TR 316243	Model: VS2000
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1100 MHz – 10000 MHz, Horizontal Polarization



1100 MHz – 10000 MHz, Vertical Polarization



Prepared For: Vulture Systems, LLC	Name: VS2000
Report: TR 316243	Model: VS2000
LSR: C-2558	Serial: 001/002

Appendix A – Test Equipment



Date : 13-Oct-2016

Type Test : Tx Radiated Emissions

Job # : C-2558

Prepared By: John Johnston

Customer : Vulture Systems

Quote # : 316243

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960155	900MHz High Pass Filter	KWM	HPF-L-14185	7272-03	4/29/2016	4/29/2017	Active Calibration
2	AA 960171	Cable - low loss 1m	A.H. Systems, Inc.	SAC-26G-6	386	3/31/2016	3/31/2017	Active Calibration
3	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	7/23/2016	7/23/2017	Active Calibration
4	EE 960160	0.8-21GHz LNA	Mini-Circuits	ZVA-213X-S+	977711030	7/23/2016	7/23/2017	Active Calibration
5	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/13/2016	5/13/2017	Active Calibration
6	AA 960156	900MHz High Pass Filter	KWM	HPF-L-14185	unknown	7/25/2016	7/25/2017	Active Calibration
7	AA 960150	Biconical Antenna	ETS	3110B	0003-3346	2/1/2016	2/1/2017	Active Calibration
8	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:



Date : 12-Oct-2016

Type Test : Conducted Measurements

Job # : C-2558

Prepared By: John Johnston

Customer : Vulture Systems

Quote # : 316243

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	44GHz EXA Spectrum Analyzer	Agilent	N9010A	MY53400296	12/19/2015	12/19/2016	Active Calibration
2	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	Verification	Verification	System

Project Engineer:

Quality Assurance:

Prepared For: Vulture Systems, LLC	Name: VS2000
Report: TR 316243	Model: VS2000
LSR: C-2558	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 $k = 2$.

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

Parameter	ETSI U.C.+/-	U.C.+/-
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-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: VS2000
Report: TR 316243	Model: VS2000
LSR: C-2558	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: VS2000
Report: TR 316243	Model: VS2000
LSR: C-2558	Serial: 001/002