LS RESEARCH, LLC
Wireless Product Development

W66 N220 Commerce Court ● Cedarburg, WI 53012 USA ● Phone: 262.375.4400 ● Fax: 262.375.4248 ● www.lsr.com

ENGINEERING TEST REPORT # TR 314378 B
LSR Job #: C-2204

Compliance Testing of:
A500 Talkman

Test Date(s):
April 30 and May 1, 4-9 2015
August 7, 2015

Prepared For:
Vocollect, Inc.
703 Rodi Road
Pittsburgh, PA 15235

This Test Report is issued under the Authority of: Adam Alger, EMC Engineer

Signature: Date: 8-7-15

Test Report Reviewed by:	**Report by:**
Tom Smith, VP EMC Test Services	Adam Alger, EMC Engineer
Signature: Date: 7-1-15	Signature: Date: 6-30-15

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LS Research, LLC in Review

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

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

Federal Communications Commission (FCC) – USA

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

Industrie Canada Industry Canada

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1
File Number: IC 3088-A
On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1
File Number: IC 3088

U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2).
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.
Date of Validation: November 20, 2002
Notified Body Identification Number: 1243

1.0 Summary of Test Report

In April-August 2015 the EUT, A500, was tested and MEETS the following requirements:

FCC Requirement	IC Requirement	Test Requirements	Measurement Procedure	Compliance (Yes/No)
15.247 (a)(1)	RSS-247 Section 5.1 (1)	Bandwidth of a Frequency Hopping System	ANSI C63.10-2013 Section 6.9	Yes
15.247(b) & 1.1310	RSS-247 Section 5.4 (2)	Maximum Output Power	ANSI C63.10-2013 Section 7.8	Yes
15.247 (a)(1)	RSS-247 Section 5.1 (2)	Carrier Frequency Separation	ANSI C63.10-2013 Section 7.8	Yes
15.247 (a)(1)(iii)	RSS-247 Section 5.1 (4)	Number of Channels and Time of Occupancy	ANSI C63.10-2013 Section 7.8	Yes
15.247(d)	RSS-247 Section 5.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	ANSI C63.10-2013 Section 7.8	Yes
15.247(c), 15.209 & 15.205	RSS-GEN Section 8.9, 8.10	Transmitter Radiated Emissions in Restricted Bands	ANSI C63.10-2013 Section (6.3,6.5,6.6)	Yes
2.1055 (d)	RSS-GEN Section 6.11	Frequency Stability	ANSI C63.10-2013 Section 6.8	Yes
15.207 15.107	RSS-GEN Section 8.8	Power Line Conducted Emissions Measurements	ANSI C63.10-2013 Section 6.2	Yes
15.109	RSS-GEN Section 7	Receive Mode (Digital Device) Radiated Emissions	ANSI C63.4-2014 Section 8	Yes

2.0 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.

3.0 Client Information

Manufacturer Name:	Vocollect, Inc.
Address:	703 Rodi Road Pittsburg, PA 15235
Contact Person:	Brian Sutton

3.1 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	A500 Talkman
Model Number:	TAP802-01
Serial Number:	Eng. Sample
FCC ID:	MQO-TAP802-01
IC:	2570A-TAP80201

3.2 Product Description

Bluetooth device using Basic Rate, EDR-2, EDR-3

3.3 Modifications Incorporated In the EUT for Compliance Purposes

None noted at time of test

3.4 Deviations & Exclusions from Test Specifications

None noted at time of test

3.5 Additional Information

Low Channel 0 (2402MHz), Middle Channel 39 (2441 MHz), High Channel 78 (2480 MHz). EUT programmed for continuous transmit or receive on selectable channel and data rate (modulation) using hyper terminal program connection via programming port on EUT.

4.0 Conditions of Test

Environmental:

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

Mains Voltage: 120 VAC 60 Hz
Battery Voltage: 3.7 V

5.0 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

6.0 Conformance Summary

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, 15.109, 15.207, 15.107 as well as Industry Canada RSS-247 Issue 1, RSS-GEN Issue 4.

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

Appendix A – Test Equipment

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 28-Apr-2015 Type Test : Radiated and RF Conducted Job # : C-2204

Prepared By: Adam Alger Customer : Vocollect Quote #: 314378

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	10/19/2014	10/19/2015	Active Calibration
2	EE 960088	8GHz MXE Spectrum Analyzer	Agilent	N9038A	MY51210138	1/9/2015	1/9/2016	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	1/19/2015	1/19/2016	Active Calibration
4	AA 960150	Biconical Antenna	ETS	3110B	0003-3346	1/22/2015	1/22/2016	Active Calibration
5	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro / EMC	WLA622-4 / 3160-09	123001	8/20/2014	8/20/2015	Active Calibration
6	AA 960137	Standard Gain Horn Ant.	EMCO	3160-10	63259	8/20/2014	8/20/2015	Active Calibration
7	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	6/20/2014	6/20/2015	Active Calibration
8	EE 960159	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-S+	740411007	6/20/2014	6/20/2015	Active Calibration
9	AA 960161	Highpass Filter	K&L Microwave	11SH10-8000	2	2/6/2015	2/6/2016	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 7-Aug-2015 Type Test : AC Emissions Job # : C-2204

Prepared By: Adam Alger Customer : Vocollect Quote #: 314378

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960162	LISN - 15A	COM-POWER	LI-215A	191969	7/24/2015	7/24/2016	Active Calibration
2	EE 960088	8GHz MXE Spectrum Analyzer	Agilent	N9038A	MY51210138	1/9/2015	1/9/2016	Active Calibration

Appendix B – Test Data
B.1 – RF Conducted Emissions

Manufacturer	Vocollect, Inc.
Test Location	LS Research, LLC
Rule Part	FCC 15.247 IC RSS-247
General Measurement Procedure	ANSI C63.10 Section 6.7
General Description of Measurement	A direct measurement of the transmitted signal was performed at the antenna port of the EUT via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by 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.

B.1.1 – RF Conducted – Fundamental Bandwidth

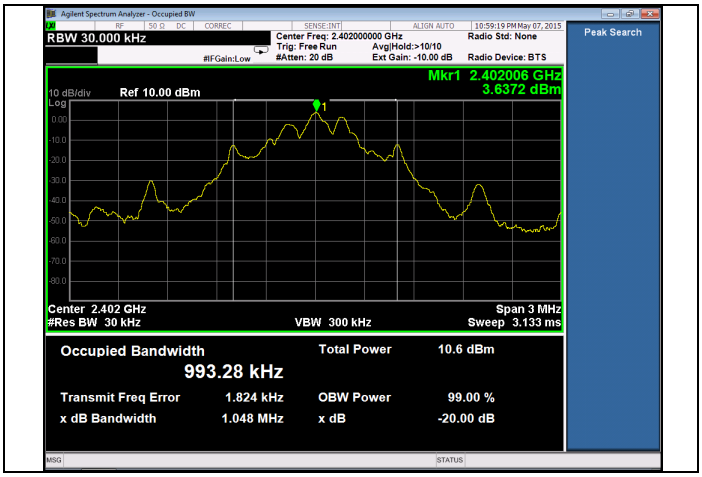
Manufacturer	Vocollect, Inc.
Date	5-7-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (a)(1) IC RSS-247 Section 5.1 (1)
Specific Measurement Procedure	ANSI C63.10-2013 Section 6.9
Additional Description of Measurement	Peak detector used
Additional Notes	Continuous transmit modulated used for this test.

Table

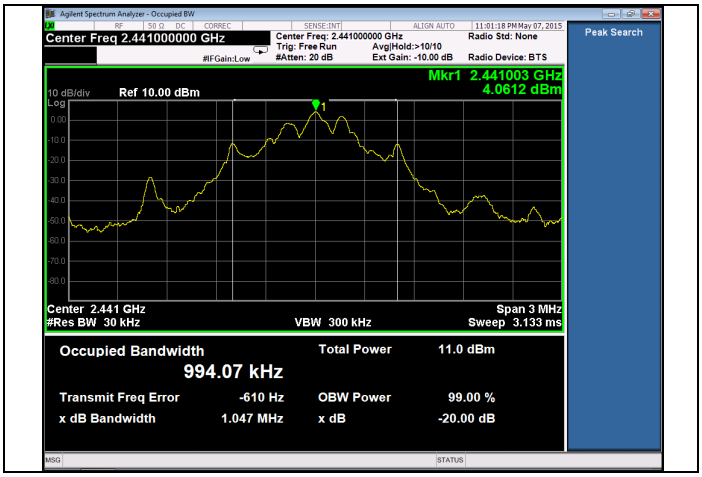
Mode	Frequency (MHz)	20 dB OBW (MHz)	99 % BW (MHz)
BR	2402	1.048	0.993
	2441	1.047	0.994
	2480	1.049	0.993
EDR-2	2402	1.165	1.096
	2441	1.161	1.092
	2480	1.161	1.091
EDR-3	2402	1.180	1.118
	2441	1.173	1.117
	2480	1.174	1.118

Plots – BR

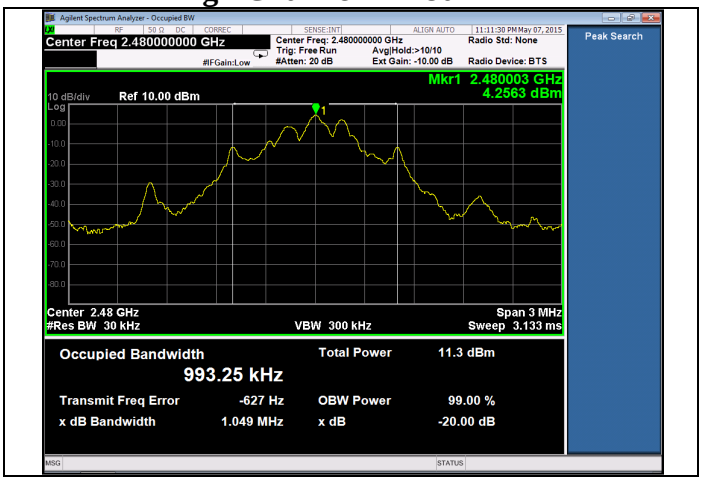
Low Channel – 2402 MHz



Mid Channel – 2441 MHz



High Channel – 2480 MHz



Plots – EDR-2

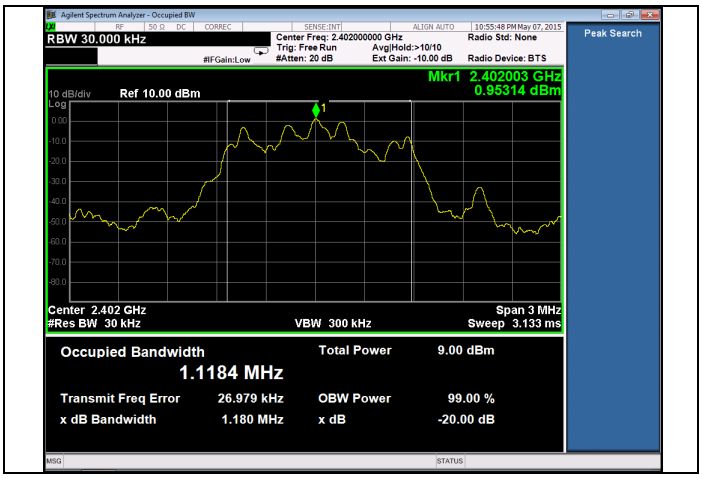
Low Channel – 2402 MHz

Mid Channel – 2441 MHz

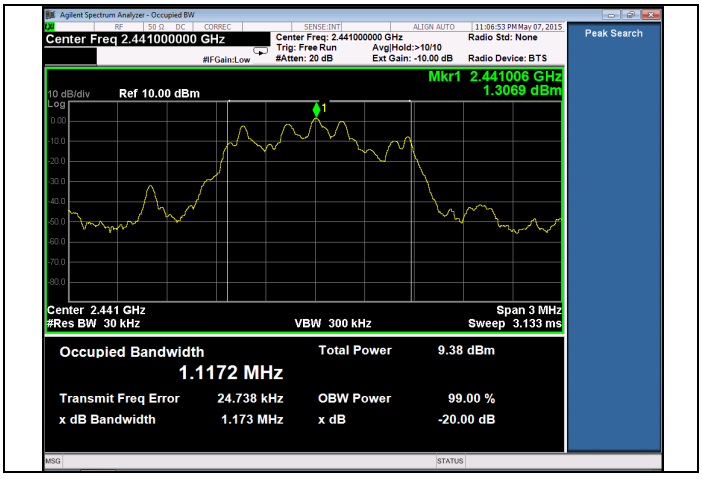
High Channel – 2480 MHz

Plots – EDR-3

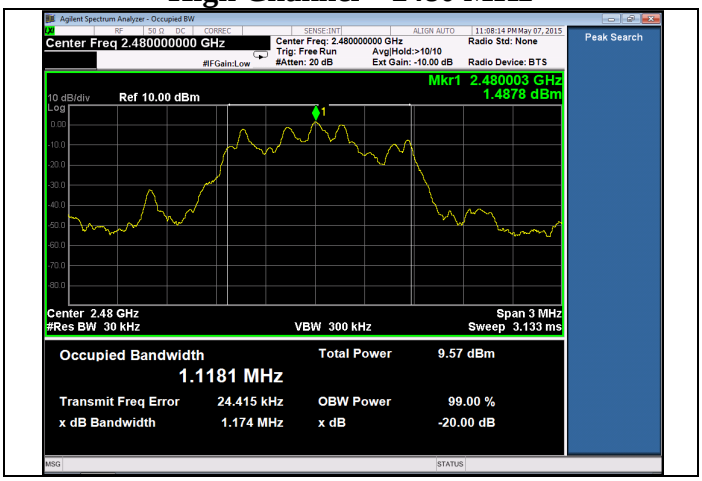
Low Channel – 2402 MHz



Mid Channel – 2441 MHz



High Channel – 2480 MHz



B.1.2 – RF Conducted – Fundamental Power

Manufacturer	Vocollect, Inc.
Date	5-7-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (b) IC RSS-247 Section 5.4 (2)
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8
Additional Description of Measurement	Peak detector with Max Hold and RBW greater than 20 dB OBW
Additional Notes	Continuous transmit modulated used for this test. Sample Calculation: Margin (dB) = Limit – Measured level

Table

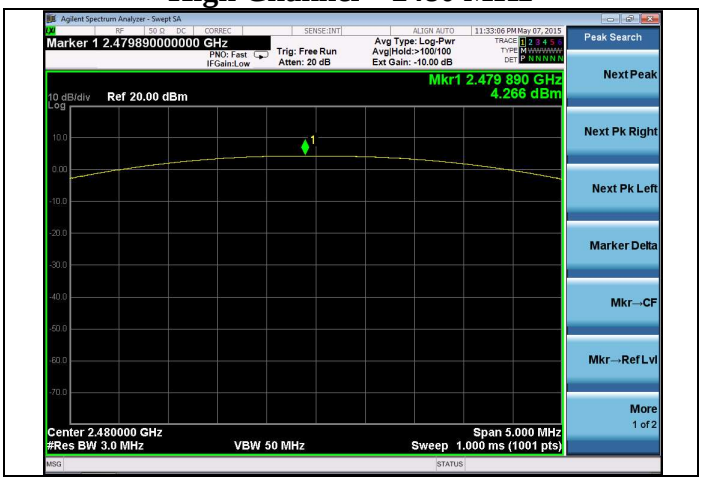
Mode	Frequency (MHz)	20 dB OBW (MHz)	99 % BW (MHz)	Output Power (dBm)
BR	2402	1.048	0.993	3.767
	2441	1.047	0.994	4.088
	2480	1.049	0.993	4.266
EDR-2	2402	1.165	1.096	1.921
	2441	1.161	1.092	2.154
	2480	1.161	1.091	2.315
EDR-3	2402	1.180	1.118	1.904
	2441	1.173	1.117	2.327
	2480	1.174	1.118	2.491

Plots – BR

Low Channel – 2402 MHz

Mid Channel – 2441 MHz

High Channel – 2480 MHz



Plots – EDR-2

Low Channel – 2402 MHz

Mid Channel – 2441 MHz

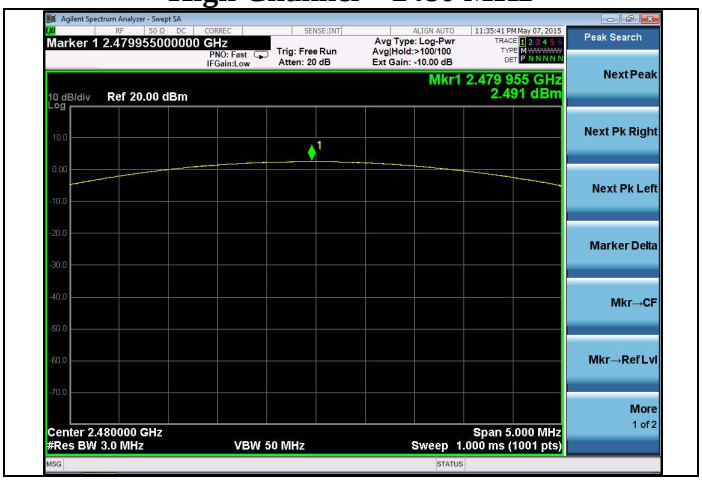
High Channel – 2480 MHz

Plots – EDR-3

Low Channel – 2402 MHz

Mid Channel – 2441 MHz

High Channel – 2480 MHz



B.1.3 – RF Conducted – Transmitter Spurious Emissions

Manufacturer	Vocollect, Inc.
Date	5-7-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (d) IC RSS-247 Section 5.5
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8
Additional Description of Measurement	Peak detector
Additional Notes	1. Non band-edge spurious tested with worst case (BR) mode. 2. Band-edge plots show continuous transmit single channel and with hopping mode enabled.

Plots start next page

Lower Band-Edge

BR – Low Channel

BR – Hopping

EDR-2 – Low Channel

EDR-2 – Hopping

EDR-3 – Low Channel

EDR-3 – Hopping

Lower Band-Edge

BR – High Channel

BR – Hopping

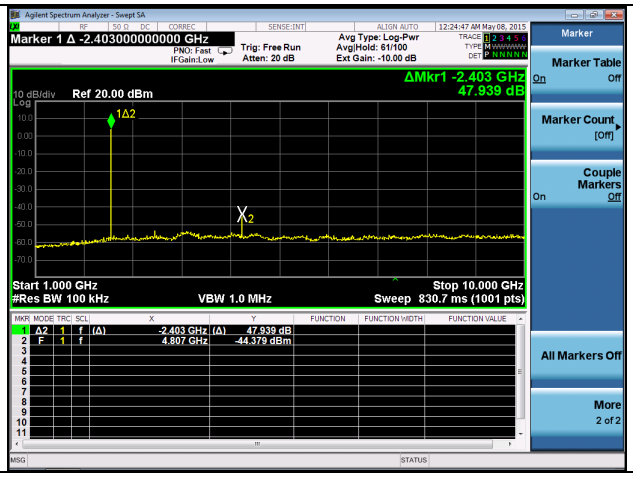
EDR-2 – High Channel

EDR-2 – Hopping

EDR-3 – High Channel

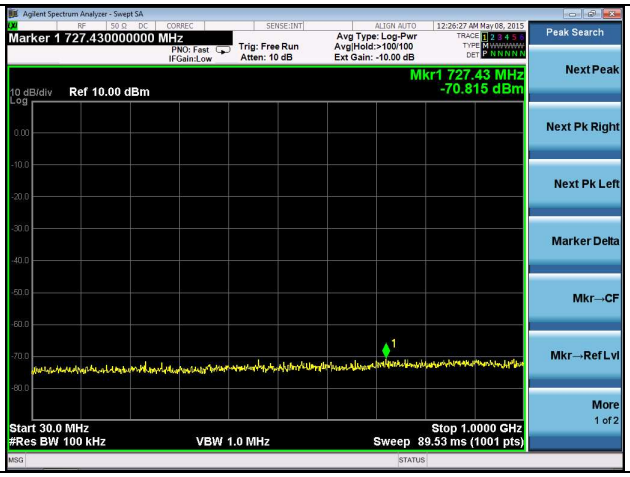
EDR-3 – Hopping

BR - Low Channel – 2402 MHz



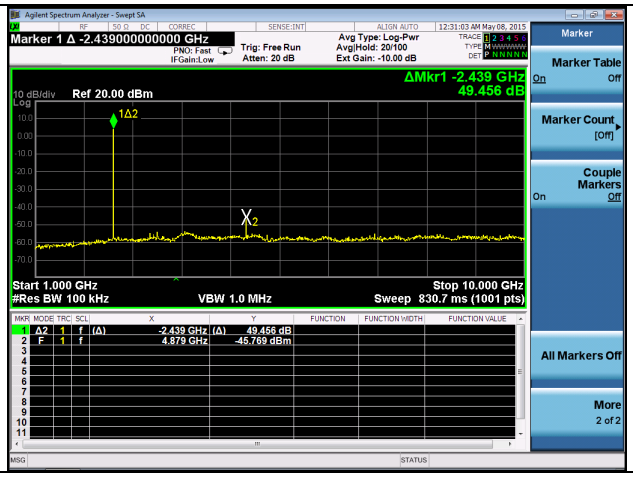
1 – 10 GHz

10-25 GHz



30-1000 MHz

BR - Mid Channel – 2441 MHz

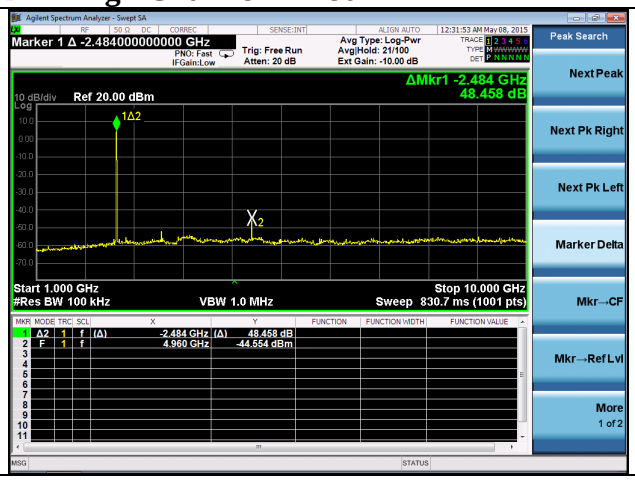


1 – 10 GHz

10-25 GHz

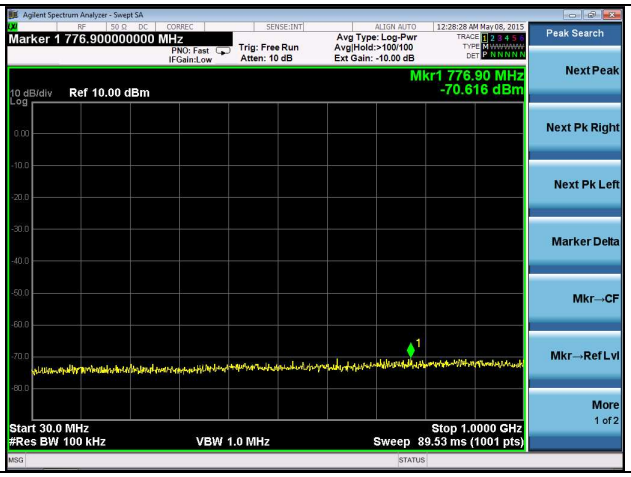
30-1000 MHz

BR - High Channel – 2480 MHz



1 – 10 GHz

10 – 25 GHz



30-1000 MHz

B.1.4 – RF Conducted – Frequency Stability

Manufacturer	Vocollect, Inc.
Date	5-7-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 2.1055 RSS-GEN Section 6.11
Specific Measurement Procedure	ANSI C63.10-2013 Section 6.8
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	The power and frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by an external bench-type DC power supply and was varied from the nominal. The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle. Below is data showing stability of the fundamental frequency. Continuous transmit un-modulated used for this test. EUT does not operate below 3.15-4.26 VDC, 3.7 VDC nominal

	3.7 VDC		4.255 VDC		3.145 VDC		
	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	FREQ DRIFT (Hz)
LOW CHANNEL	3.5	240299860	3.4	240299855	3.5	240299850	10
MID CHANNEL	3.8	243999840	3.9	243999845	3.8	243999840	5
HIGH CHANNEL	3.9	247899835	4.0	247899840	3.9	247899845	10

B.1.5 – RF Conducted – Carrier Frequency Separation, Number of Channels, and Time of Occupancy

Manufacturer	Vocollect, Inc.
Date	5-7-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (a)(1) & (a)(1)(iii) IC RSS-247 Section 5.1 (2) & 5.1 (4)
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	Hopping mode enabled – BR DH5 found to be worst case mode

Carrier Frequency Separation = 1.0 MHz > two-thirds of the 20 dB BW of the hopping channel when operating with output power less than 125 mW.

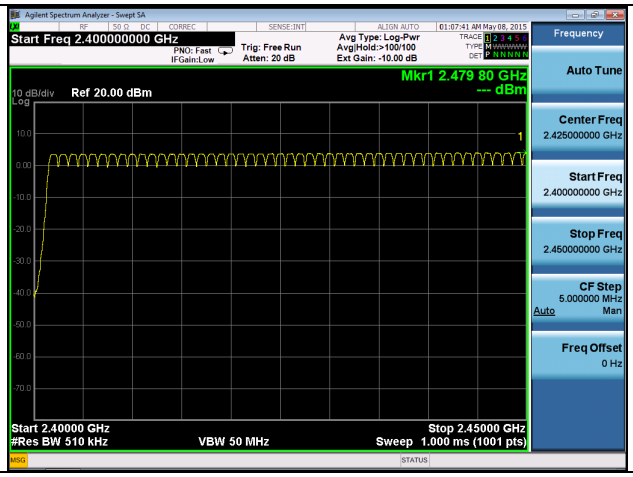
Number of Channels = 79

Time of Occupancy = 0.4 seconds with a period of 0.4 seconds multiplied by the number of hopping channels employed.

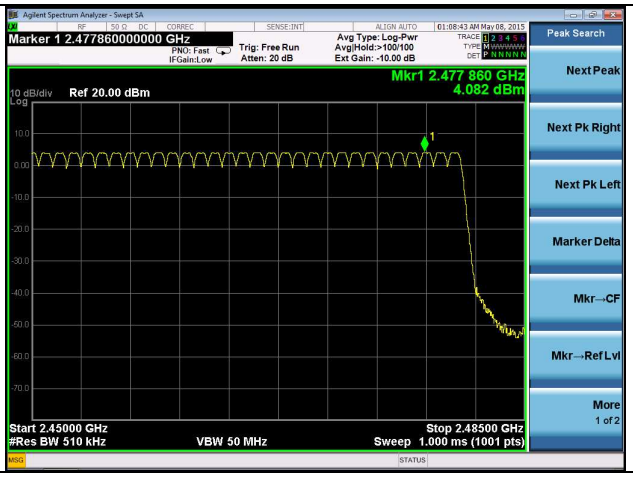
0.4 s x 79 = 31.6 s
Dwell Time = 2.94 ms
Number of Hops in 3.12 s = 4
2.94 ms x 4 x 10 = .118 s < 0.4 in 31.6 s

Packet Type	Time of Occupancy
DH1	0.380 ms
DH3	1.6 ms
DH5	2.94 ms
2-DH1	0.390 ms
2-DH3	1.65 ms
2-DH5	2.89 ms
3-DH1	0.390 ms
3-DH3	1.64 ms
3-DH5	2.92 ms

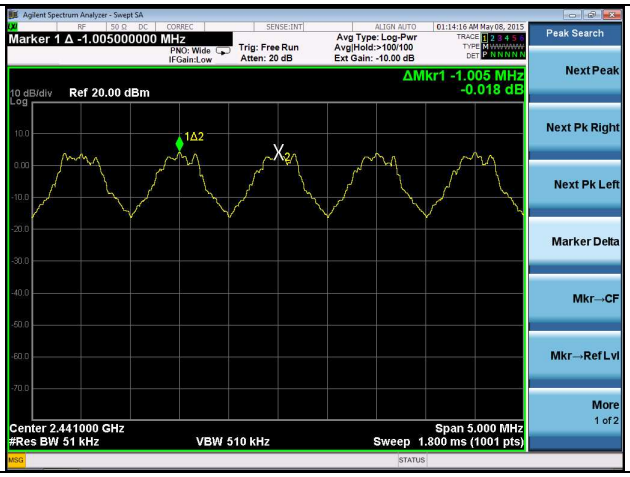
Plots



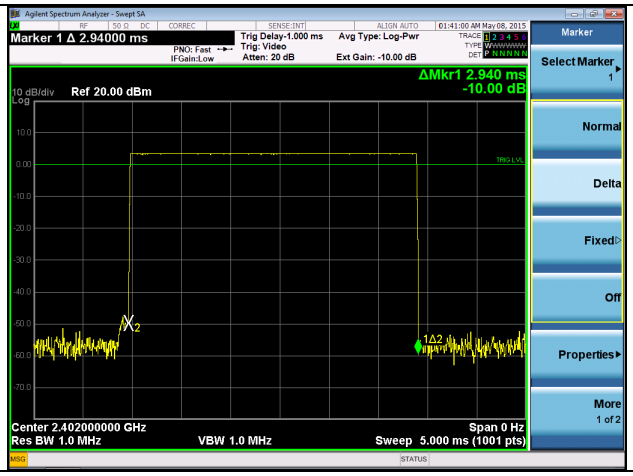
Number of Channels (lower half)



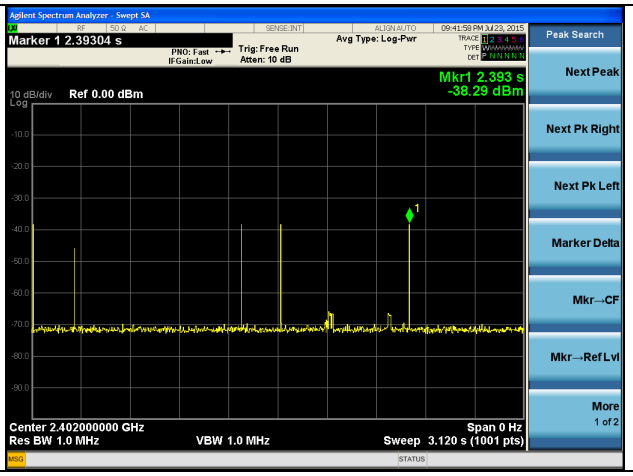
Number of Channels (upper half)



Carrier Frequency Separation



Dwell Time



Number of Pulses

B.2 – Transmitter Radiated Emissions in Restricted Bands

Rule Part(s)	FCC: 15.247 / 15.205 / 15.209 IC: RSS-GEN Section 8.9,8.10			
Measurement Procedure	ANSI C63.10 – 2013 Section 6.3,6.5,6.6			
Test Location	LS Research, LLC – FCC/IC Listed 3 meter Chamber			
Test Distance	See data section			
EUT Placement	Above 1 GHz: 150 cm height non-conductive table above reference ground plane covered with absorbers Below 1 GHz: 80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-300 MHz	Log Periodic Dipole Array: 300-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	Standard Gain Horn: 18-26GHz
Measurement Detectors	30-1000MHz RBW: 120 kHz VBW: At least 300 kHz		1 - 40 GHz: RBW : 1MHz VBW: At least 3 MHz Peak VBW: ≤ 30 Hz Average	
Description of Measurement	1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna at the test distance from the EUT 3) 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.			
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)			

Limits:

Frequency (MHz)	3 m Limit (µV/m)	3 m Limit (dBµV/m)	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	Average (>1 GHz)

B.2.1 – Radiated Band-Edge Restricted Bands

Manufacturer	Vocollect, Inc.
Date	5-4-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 6.3, 6.6
Test Distance	3 meter
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Final Measurements: Peak / Max Hold, RBW 1 MHz, Average VBW 10Hz, Peak VBW 3 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported.

Example Calculation:
Limit (dBµV/m) – Reading (dBµV/m) = Margin (dB)

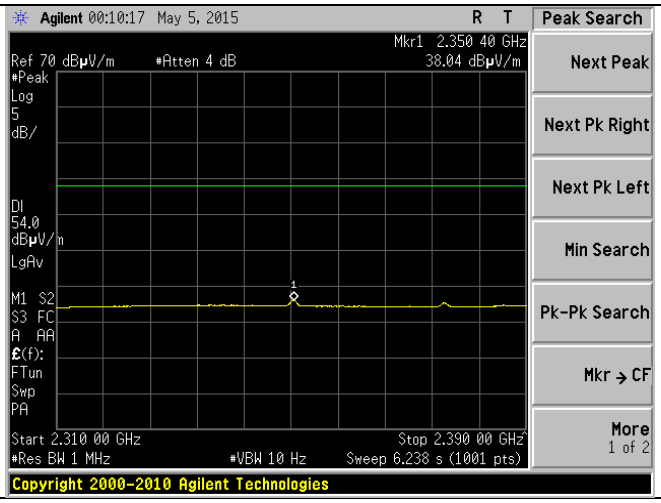
Table
Average

Mode	Channel	Frequency (GHz)	Avg Meas (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)
BR	0	2.35040	38.04	54	16.0
	78	2.48350	40.33		13.7
EDR-2	0	2.35032	37.61		16.4
	78	2.48350	38.76		15.2
EDR-3	0	2.35016	37.54		16.5
	78	2.48350	39.64		14.4

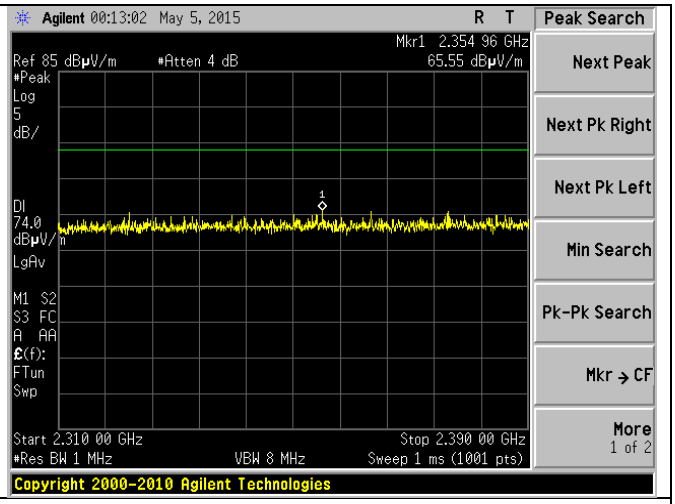
Peak

Mode	Channel	Frequency (GHz)	Peak Meas (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
BR	0	2.35496	65.55	74	8.5
	78	2.48829	65.82		8.2
EDR-2	0	2.36704	64.40		9.6
	78	2.49213	65.44		8.6
EDR-3	0	2.36424	63.44		10.6
	78	2.49027	65.84		8.2

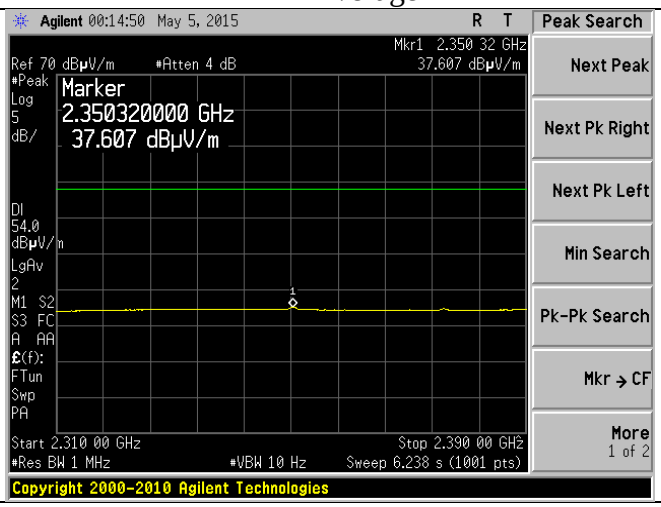
Plots - Low Channel



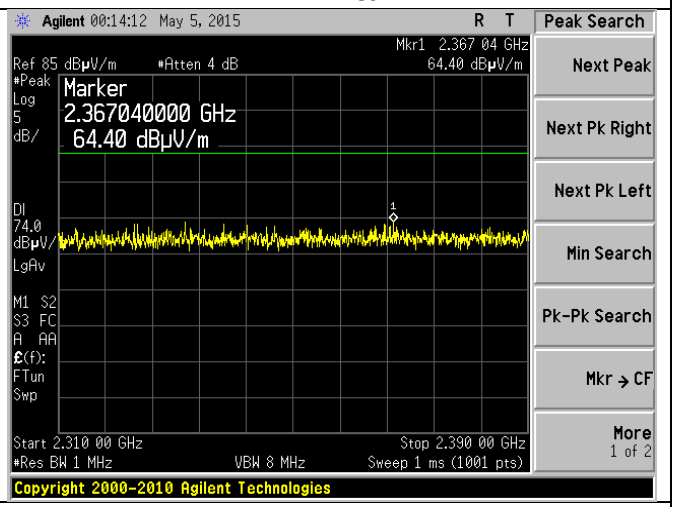
BR – Average



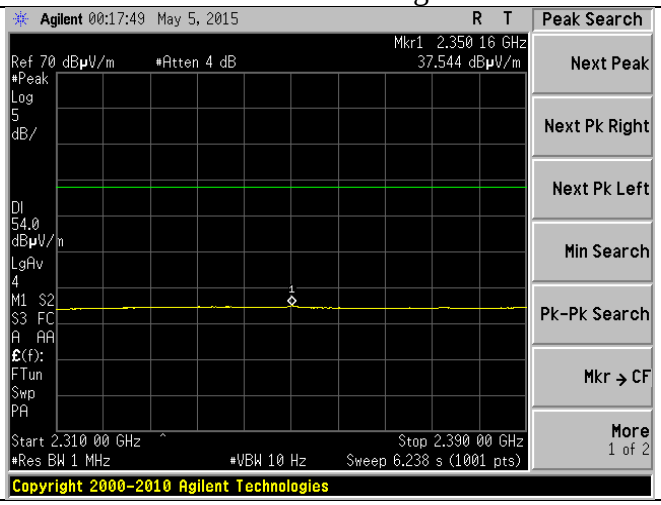
BR – Peak



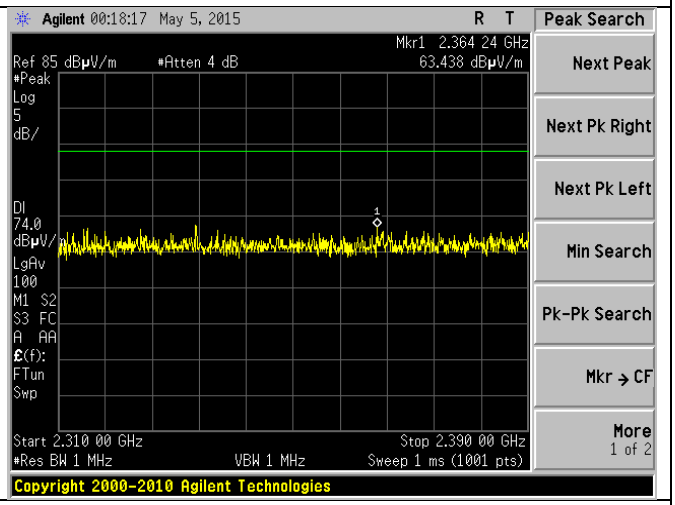
EDR-2 – Average



EDR-2 – Peak

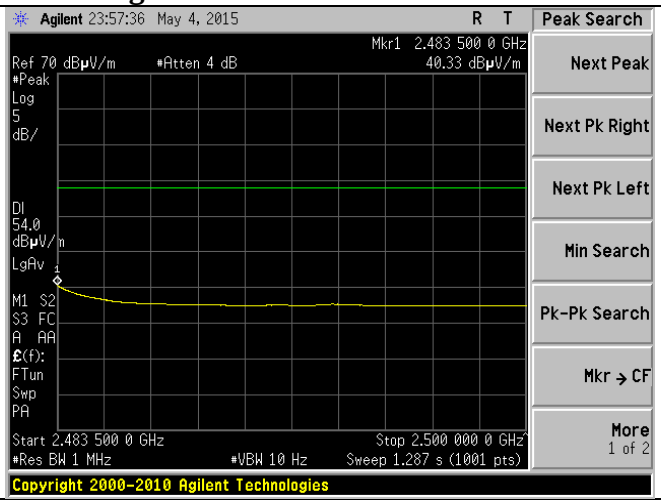


EDR-3 – Average

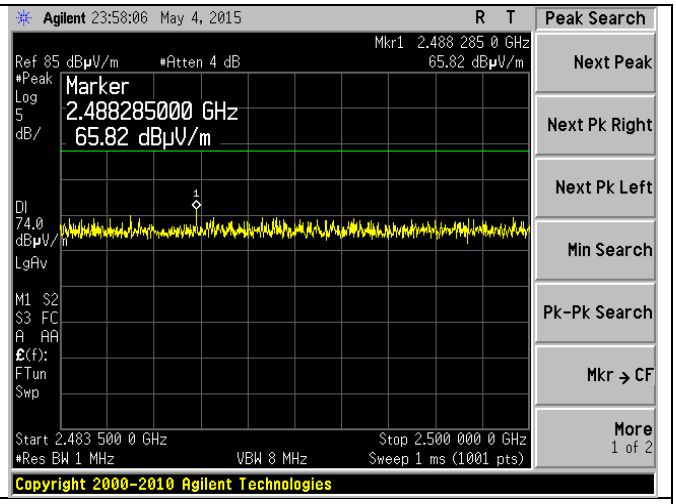


EDR-3 – Peak

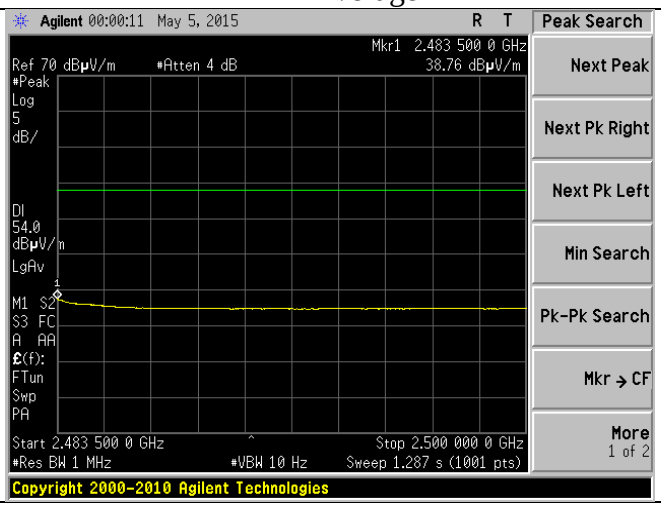
Plots - High Channel



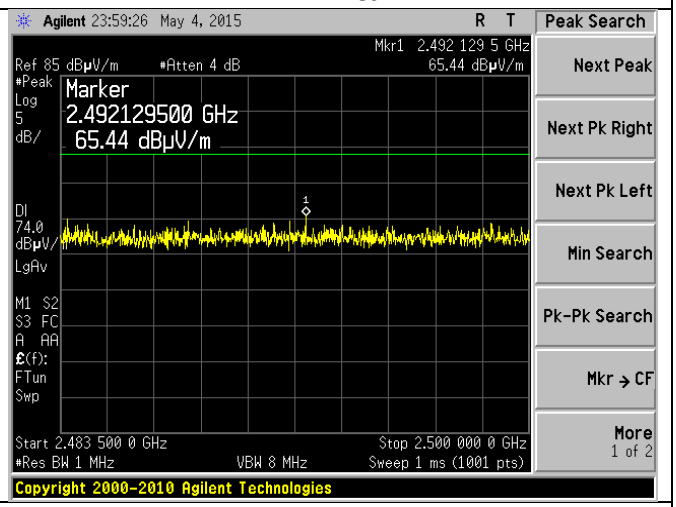
BR – Average



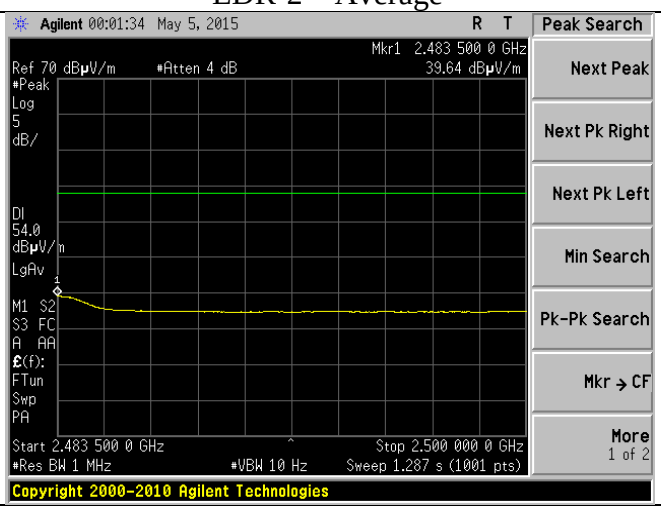
BR – Peak



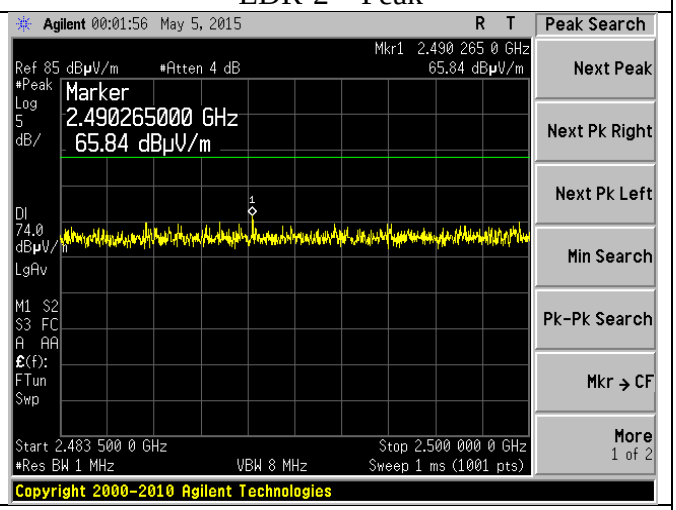
EDR-2 – Average



EDR-2 – Peak



EDR-3 – Average



EDR-3 – Peak

B.2.2 – Radiated Harmonics in Restricted Bands

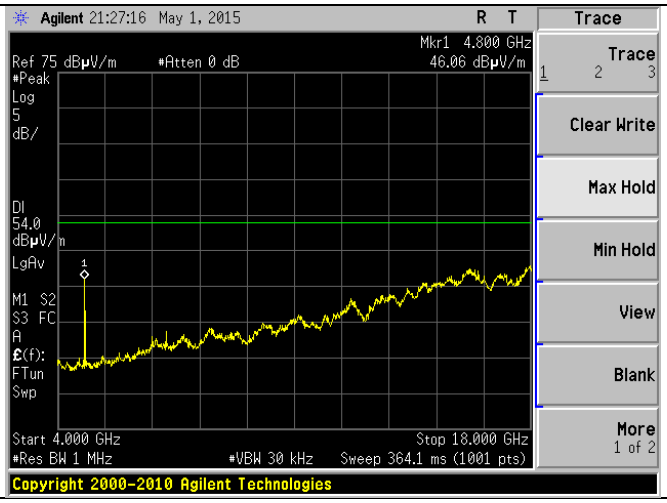
Manufacturer	Vocollect, Inc.
Date	5-1-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 6.3, 6.6
Test Distance	3 meter
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Final Measurements: Peak / Max Hold, RBW 1 MHz, Average VBW 30Hz, Peak VBW 3 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported. 2) Worst case mode (BR) measured.

Example Calculation:
Limit (dBµV/m) – Reading (dBµV/m) = Margin (dB)

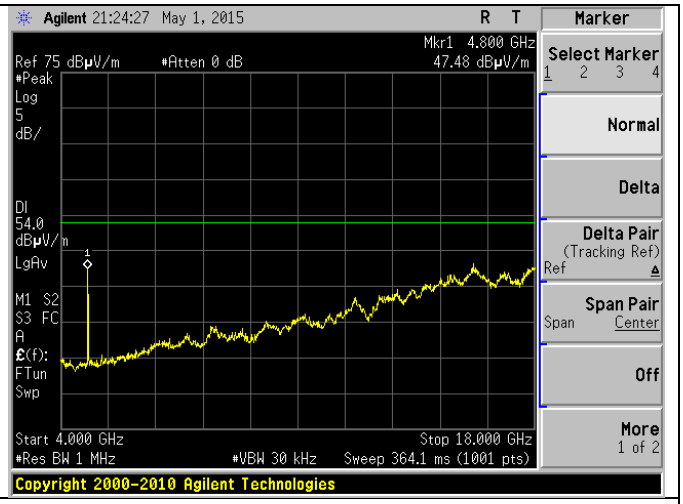
Table

EUT Channel	Frequency (MHz)	EUT orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBµV/m)	Peak Reading (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)	Peak Limit (dBµV/m)	Peak Margin (dB)
0	4804	Horizontal	Horizontal	170	57	43.34	57.20	54	10.7	74	16.8
		Vertical	Vertical	103	86	43.35	57.39		10.7		16.6
39	4882	Horizontal	Horizontal	165	63	45.84	58.01		8.2		16.0
		Vertical	Vertical	109	84	45.47	57.14	54	8.5	74	16.9
78	4960	Horizontal	Horizontal	146	62	45.18	57.26		8.8		16.7
		Vertical	Vertical	122	67	45.62	58.43		8.4		15.6

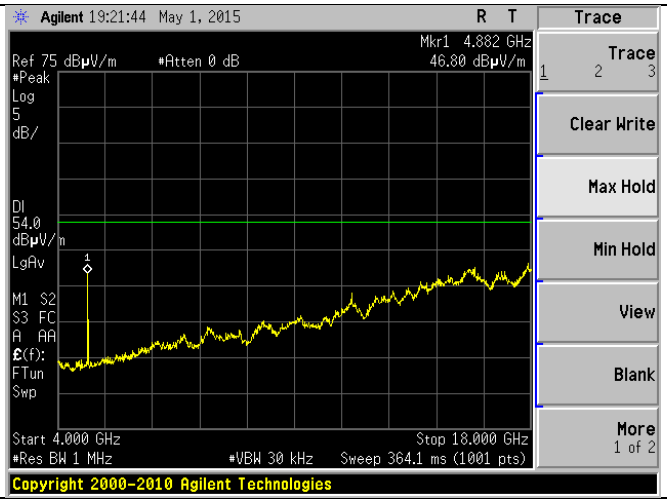
Plots



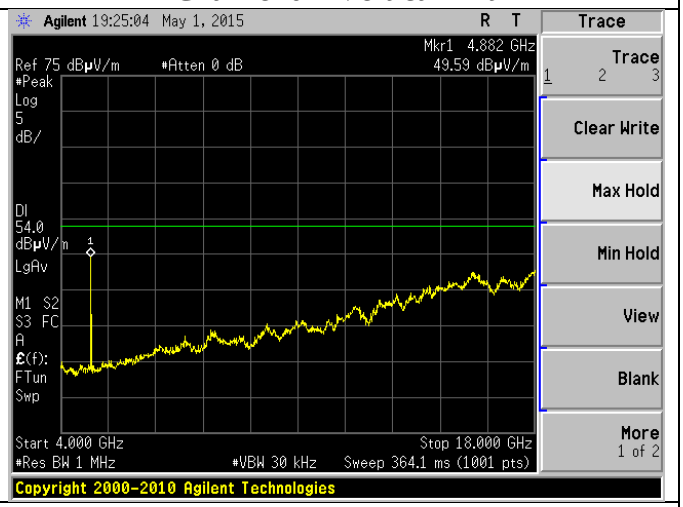
Channel 0 – Horizontal Ant



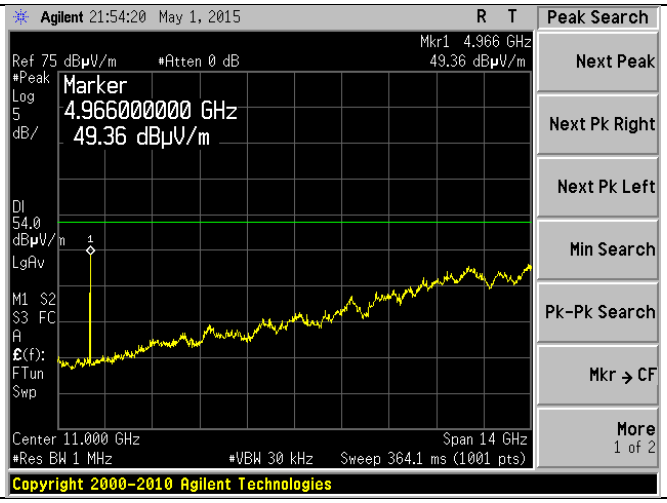
Channel 0 – Vertical Ant



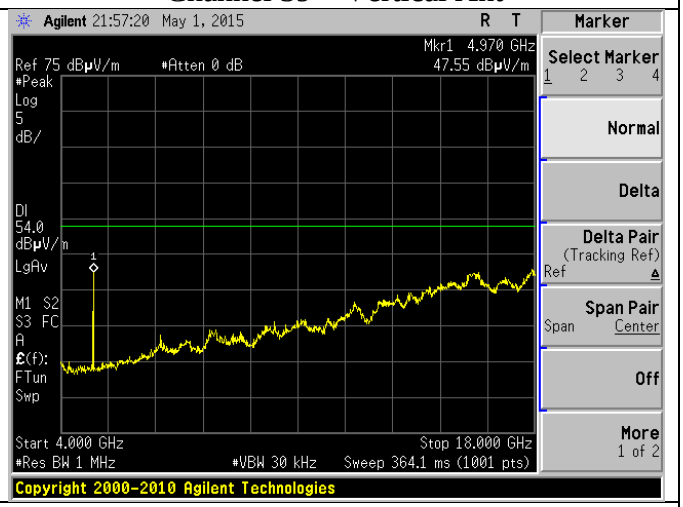
Channel 39 – Horizontal Ant



Channel 39 – Vertical Ant



Channel 78 – Horizontal Ant



Channel 78 – Vertical Ant

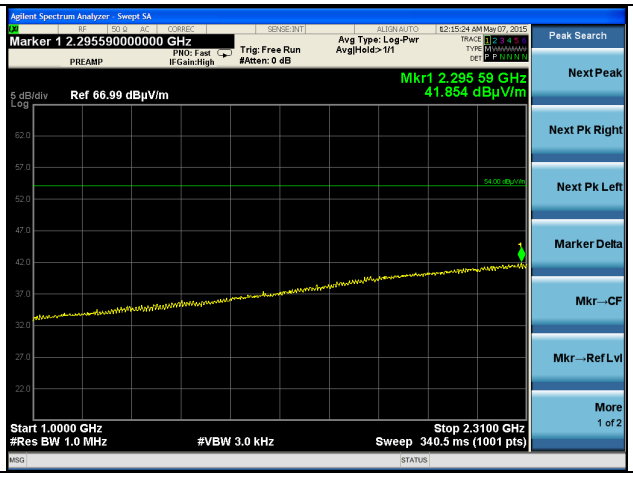
B.2.3 – Radiated Spurious Emissions Transmit Mode (1-26 GHz)

Manufacturer	Vocollect, Inc.
Date	5-5, 5-6, 5-7 2015
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 6.3, 6.6
Test Distance	3 meter 1-18 GHz 1 meter 18-26 GHz
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Peak; RBW 1 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported. 2) No Emissions found above system noise floor 3) Frequency ranges 2310-2390 MHz, 2483.5-2500 MHz, and 4-18 GHz seem in previous sections.

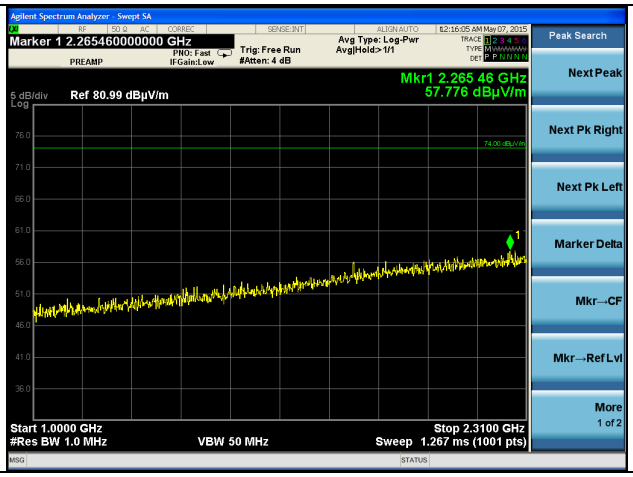
Example Calculation:

Limit (dBµV/m) – Reading (dBµV/m) = Margin

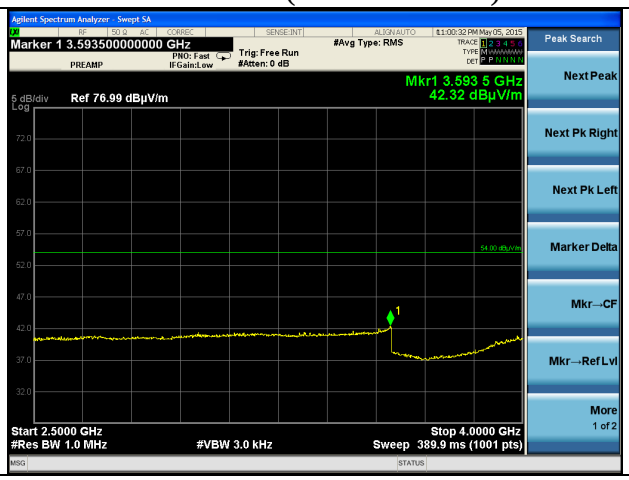
Plots



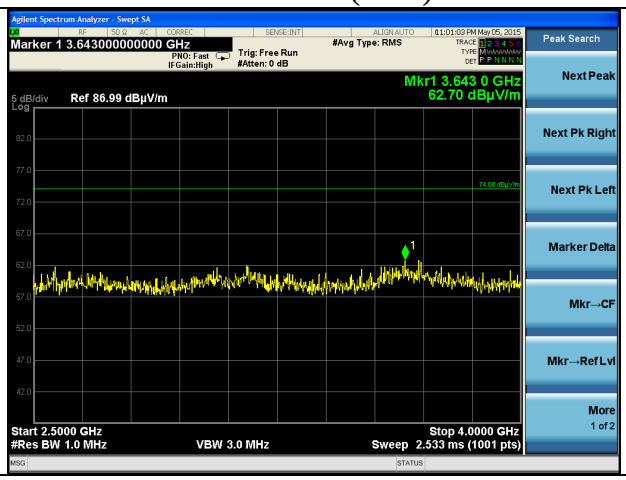
1-2.31 GHz (Reduced VBW)



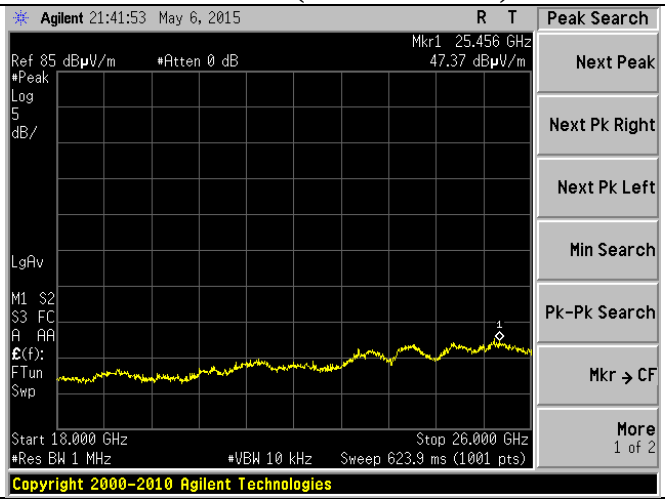
1-2.31 GHz (Peak)



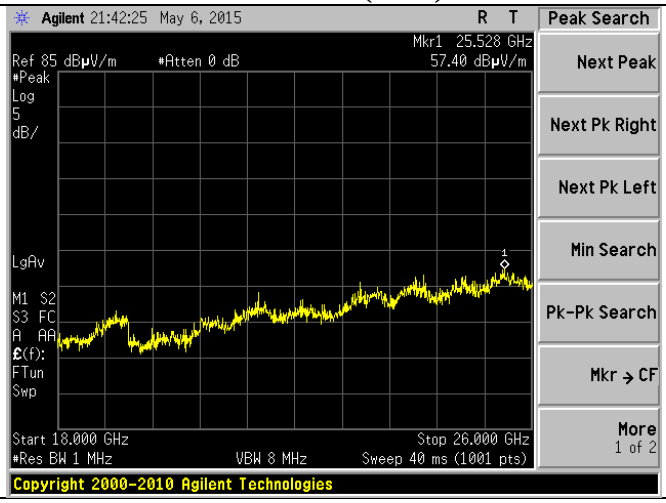
2.5-4 GHz (Reduced VBW)



2.5-4 GHz (Peak)



18-26 GHz (Reduced VBW)



18-26 GHz (Peak)

B.2.4 – Radiated Spurious Emissions Transmit Mode (30-1000 MHz)

Manufacturer	Vocollect, Inc.
Date	5-8, 5-9 2015
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 6.3, 6.5
Test Distance	3 meter 30-1000 MHz
EUT Placement	80 cm height non-conductive table centered on turn-table (no absorbers on ground plane)
Detectors	Peak; RBW 120 kHz
Additional Notes	1) Tested in continuous transmit modulated mode with EUT in three orientations at maximum power. 2) Emissions not effected by channel or modulation.

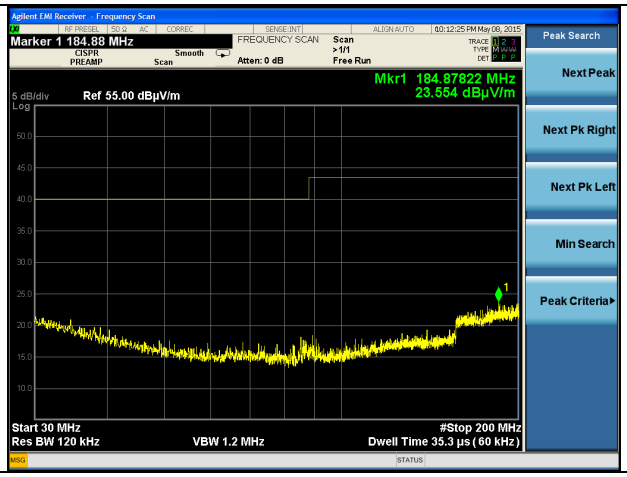
Example Calculation:

Limit (dBµV/m) – Reading (dBµV/m) = Margin

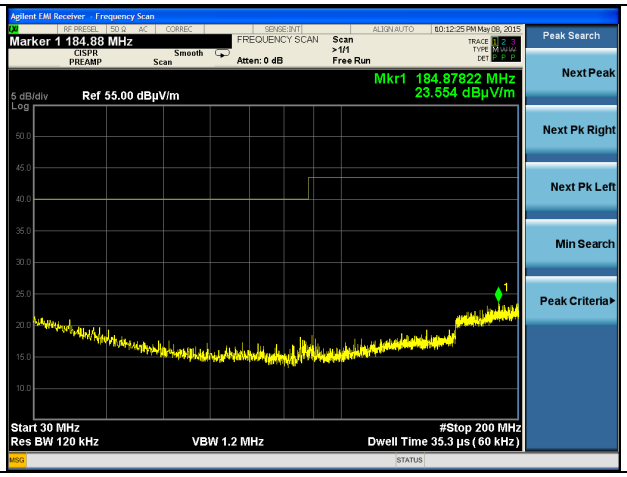
Table

Frequency (MHz)	Antenna Polarity	Azimuth (degree)	Height (cm)	Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Margin (dB)	Comment
85.86	Horizontal	187	202	22.27	40.0	17.7	Not related to transmitter
184.87	Vertical	0	100	23.55	43.5	20.0	Noise Floor
992.26	Horizontal	0	100	34.11	54.0	19.9	Noise Floor
858.87	Vertical	0	100	34.15	46.0	11.9	Noise Floor

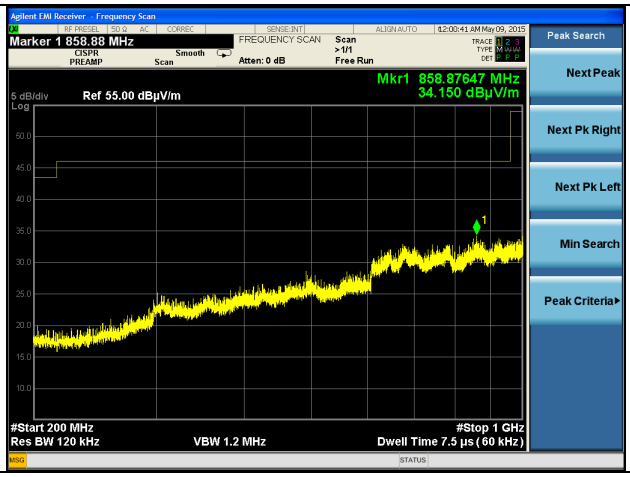
Plots



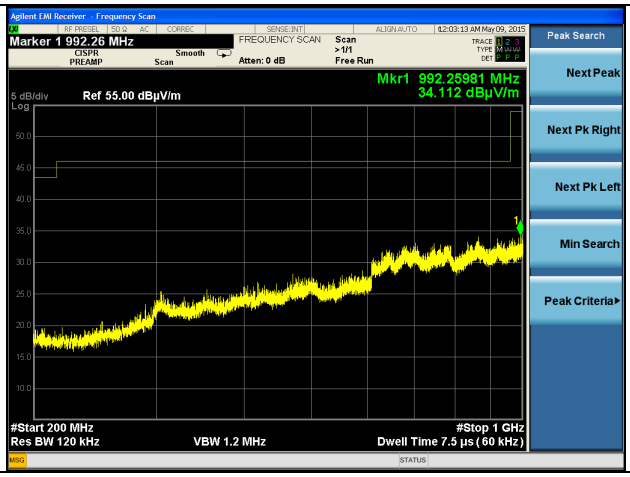
30-200 MHz Vertical



30-200 MHz Horizontal



200-1000 MHz Vertical



200-1000 MHz Horizontal

B.3 – Radiated Emissions in Receive Mode

Rule Part(s)	FCC: 15.109 IC: RSS-GEN Section 7			
Measurement Procedure	ANSI C63.4-2014 Section 8			
Test Location	LS Research, LLC – FCC/IC Listed 3 meter Chamber			
Test Distance	See data section			
EUT Placement	Above 1 GHz: 80 cm height non-conductive table above reference ground plane covered with absorbers Below 1 GHz: 80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-300 MHz	Log Periodic Dipole Array: 300-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	Standard Gain Horn: 18-26GHz
Measurement Detectors	30-1000MHz RBW: 120 kHz VBW: At least 300 kHz		1 - 40 GHz: RBW : 1MHz VBW: At least 3 MHz Peak VBW: 30 Hz Average	
Description of Measurement	1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna at the test distance from the EUT 3) 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.			
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)			

Limits:

Frequency (MHz)	3 m Limit (µV/m)	3 m Limit (dBµV/m)	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	Average (>1 GHz)

B.3.1 – Radiated Spurious Emissions Receive Mode (30-1000 MHz)

Manufacturer	Vocollect, Inc.
Date	5-8, 5-9 2015
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.109 IC RSS-GEN
Measurement Procedure	ANSI C63.4-2013 Section 8
Test Distance	3 meter 30-1000 MHz
EUT Placement	80 cm height non-conductive table centered on turn-table (no absorbers on ground plane)
Detectors	Peak; RBW 120 kHz
Additional Notes	1) Tested in continuous receive mode with EUT in three orientations 2) Emissions not effected by channel

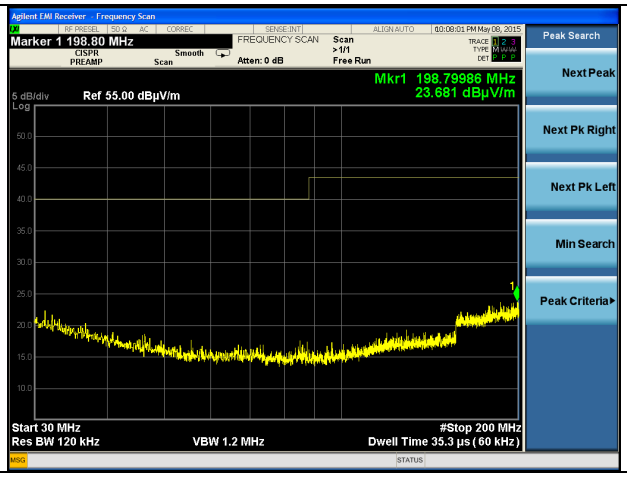
Example Calculation:

Limit (dBµV/m) – Reading (dBµV/m) = Margin

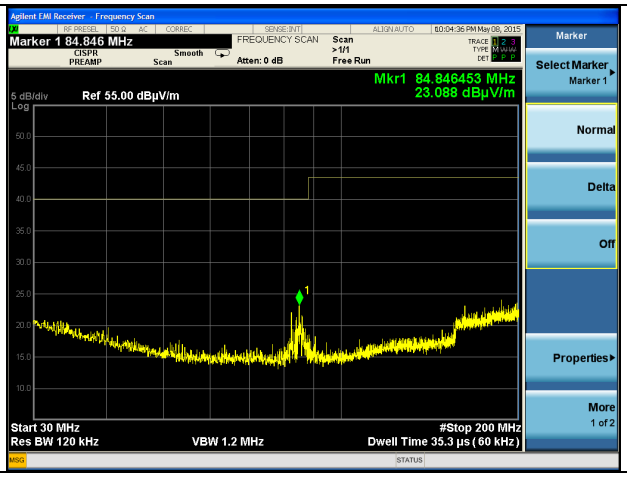
Table

Frequency (MHz)	Antenna Polarity	Azimuth (degree)	Height (cm)	Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Margin (dB)	Comment
85.86	Horizontal	187	202	22.27	40.0	17.7	Not related to transmitter
198.79	Vertical	0	100	23.68	43.5	19.8	Noise Floor
868.05	Horizontal	0	100	34.13	46.0	11.9	Noise Floor
865.89	Vertical	0	100	34.25	46.0	11.8	Noise Floor

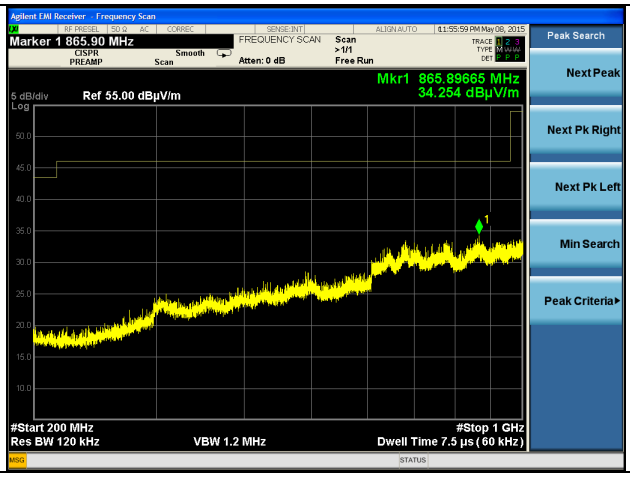
Plots



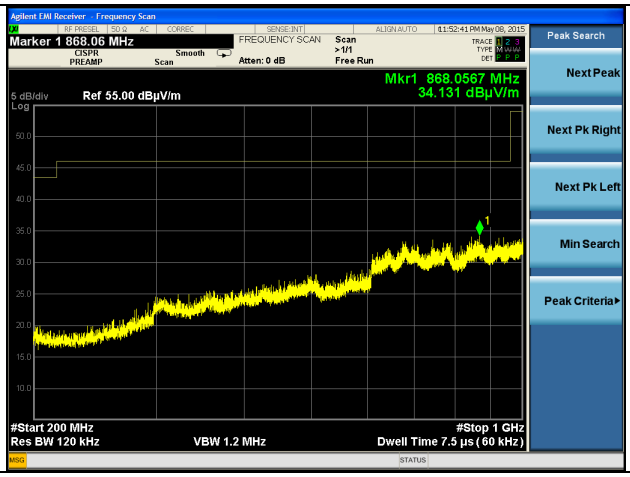
30-200 MHz Vertical



30-200 MHz Horizontal



200-1000 MHz Vertical



200-1000 MHz Horizontal

B.3.2 – Radiated Spurious Emissions Receive Mode (1-26 GHz)

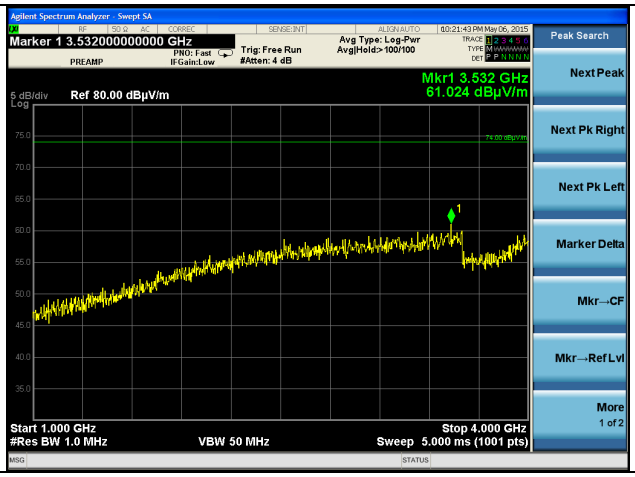
Manufacturer	Vocollect, Inc.
Date	4-30, 5-6 2015
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.109 IC RSS-GEN
Measurement Procedure	ANSI C63.4-2013 Section 8
Test Distance	3 meter 1-18 GHz 1 meter 18-26 GHz
EUT Placement	80 cm height non-conductive table centered on turn-table (absorbers on ground plane)
Detectors	Peak; RBW 120 kHz
Additional Notes	1) Tested in continuous receive mode with EUT in three orientations 2) Emissions not effected by channel 3) No Emissions found above system noise floor

Example Calculation:

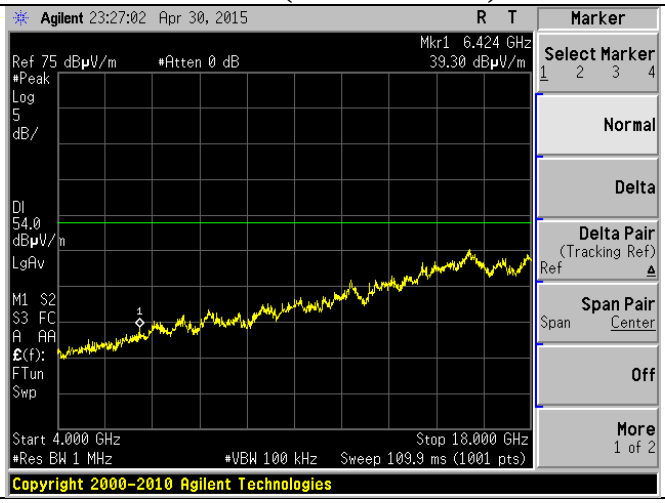
Limit (dBµV/m) – Reading (dBµV/m) = Margin

Plots

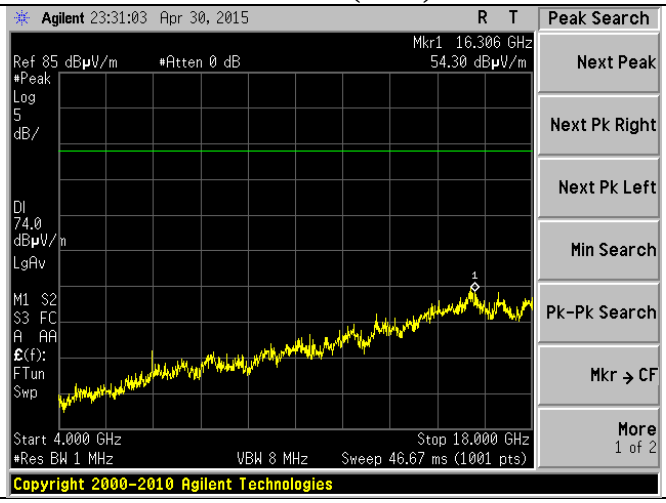
1-4 GHz (Reduced VBW)



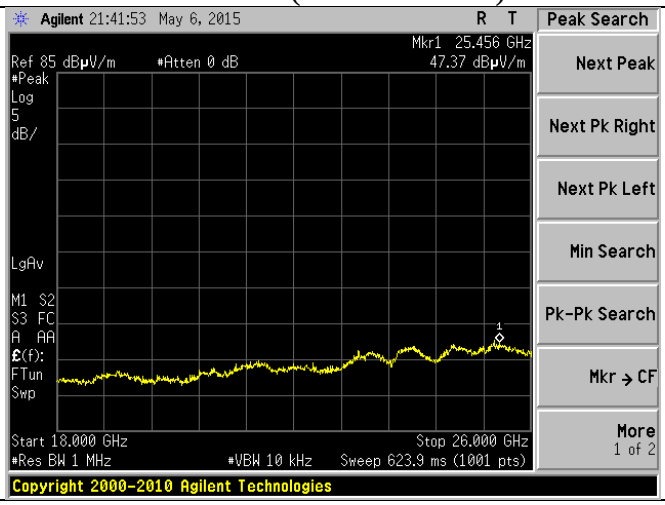
1-4 GHz (Peak)



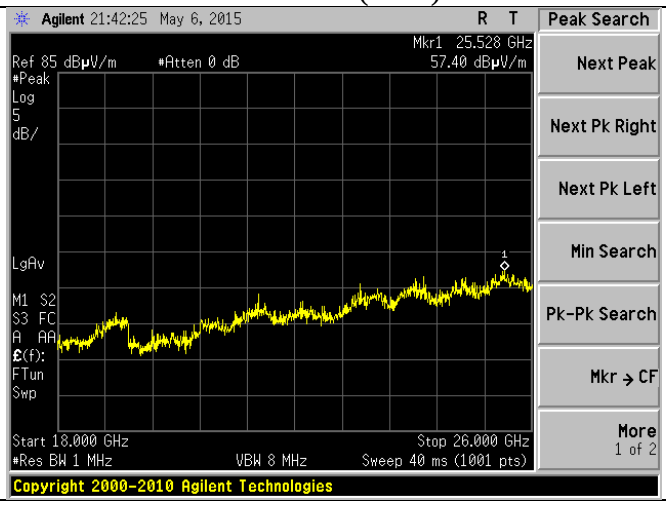
4-18 GHz (Reduced VBW)



4-18 GHz (Peak)



18-26 GHz (Reduced VBW)



18-26 GHz (Peak)

B.4 – AC Mains Conducted Emissions

Rule Part(s)	FCC: 15.207 / 15.107 IC: RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 – 2013
Test Location	LS Research, LLC – Conducted Emissions Area
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table above reference ground plane
Frequency Range of Measurement	150 kHz – 30 MHz
Measurement Detectors	Peak, Quasi-Peak, Average RBW: 9 kHz VBW: At least 27 kHz
Description of Measurement	1) The LISN, cable, limiter, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal at appropriate distance from ground planes and plugged into LISN. The LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral). 3) Maximum emissions are determined with peak detector and measurements at select points are made with quasi-peak and average detectors. Results are recorded and compared to limit.
Example Calculations	Reported Measurement data = Raw receiver measurement + LISN Factor + Cable factor (dB) + Additional factor (when applicable)

Limits of Conducted Emissions at the AC Mains Ports:

Frequency Range (MHz)	Class B Limits (dBµV)	
	Quasi-Peak	Average
0.150 -0.50 *	66-56	56-46
0.5 – 5.0	56	46
5.0 – 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

B.4.1 – AC Mains Conducted Emissions

Manufacturer	Vocollect
Date	8-7-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	15.207 / 15.107 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 - 2013 Section 6.2
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table, 40 cm from vertical ground plane
Detectors	Peak; RBW 9 kHz Quasi-Peak and Average
Additional Notes	1) Tested in continuous transmit and receive with no significant difference between operating channels.

Example Calculation:

Margin (dB) = Limit (dBµV) – Reading (dBµV)

Table

Frequency (MHz)	Line	Peak Reading (dBµV)	Quasi-Peak Reading (dBµV)	Average Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Limit (dBµV)	Average Margin (dB)
0.154	1	55.6	48.2	34.6	65.8	17.6	55.8	21.2
0.195	1	53.3	44.1	31.7	63.8	19.7	53.8	22.1
0.218	1	50.5	42.5	30.6	62.9	20.4	52.9	22.3
0.150	2	54.5	47.6	29.2	66.0	18.4	56.0	26.8
0.190	2	50.1	42.5	24.3	64.0	21.5	54.0	29.7
0.276	2	42.2	35.5	22.7	60.9	25.4	50.9	28.2

Plots

Line 1

Line 2

Appendix C - Uncertainty Summary

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

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.82 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.88 dB
Radiated Emissions	3-Meter Chamber, Horn Antenna	4.85 dB
Absolute Conducted Emissions	Agilent PSA/ESA Series	1.38 dB
AC Line Conducted Emissions	Shielded Room/EMCO LISN	3.20 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	2.05 Volts/Meter
Conducted Immunity	3 Volts level	2.33 V
EFT Burst, Surge, VDI	230 VAC	54.4 V
ESD Immunity	Discharge at 15kV	3200 V
Temperature/Humidity	Thermo-hygrometer	0.64°/ 2.88 %RH

Appendix D - References

Publication	Year	Title
FCC CFR Parts 0-15	2015	Code of Federal Regulations – Telecommunications
RSS-247 Issue 1	2015	Digital Transmissions Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing Unlicensed Wireless Devices

END OF REPORT

Date	Version	Comments	Person
6-30-15	V0	Initial Draft Release	Adam A
7-1-15	V1	Final Release	Adam A
7-24-15	V1a	TCB comments addressed	Adam A
8-5-15	V1b	TCB comments addressed	Adam A
8-7-15	V1c	Added AC Emissions	Adam A