TEST REPORT

Report Number: 101673436DEN-001
Project Number: G101673436

Report Issue Date: 8/14/2014

Product Designation: **Model: EN1221S-60**

Standards: **FCC title 47 CFR part 15 subpart C (Part 15.247)**
RSS-210, Issue 8: 2010
RSS-GEN, Issue 3: 2010
CISPR 22: 2008

Tested by:
Intertek Testing Services NA, Inc.
1795 Dogwood St. Suite 200
Louisville, CO 80027

Client:
Inovonics Wireless Corp.
397 South Taylor Ave.
Louisville, CO 80027

Report prepared by
Randy Thompson
Senior EMC Project Engineer

Report reviewed by
Jason Centers
Staff Engineer

TABLE OF CONTENTS

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 3.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the **product tested Complies with the requirements of the standard(s) indicated.** The results obtained in this test report pertain only to the item(s) tested.

2 Test Summary

Section	Test full name	Test date	Result
5	Radiated Emissions – Output Power of the Tx Fundamental - FCC 247(b)(2) Covers RSS-210 A8.4(1)	07/02/2014	Pass
6	Radiated Emissions – Tx Harmonics of the Fundamental – Includes Restricted Band - FCC 247(d)/ 15.209(a)/15.205 Covers RSS-210 A8.5/ RSS-GEN, 7.2.2	07/02/2014	Pass
7	Tx Band Edge & Restricted Band – FCC 15.247(d)/15.205/209 Covers RSS-210 A8.5/RSS-GEN, 7.2.2	07/03/2014	Pass
8	Radiated Emissions – Tx Spurious Emissions – 20dBc (Harmonics & Non Harmonics) - FCC 15.247(d) Covers RSS-210 A8.5	07/03/2014	Pass
9	Radiated Emissions – Idle/Standby Unintentional Emissions - FCC 15.109/ CISPR 22 Covers RSS-GEN, 7.2.5	07/03/2014	Pass
10	20 dB Bandwidth – FCC 15.247 (a)(1)(i) Covers RSS-210 A8.1(c)	07/03/2014	Pass
11	Carrier Frequency Separation – FCC 15.247 (a)(1) Covers RSS-210 A8.1(b)	07/03/2014	Pass
12	Number of Hopping Frequencies – FCC 15.247 (a)(1)(i) Covers RSS-210 A8.1(c)	07/03/2014	Pass
13	Time of Occupancy (Dwell Time) – FCC 15.247 (a)(1)(i) Covers RSS-210 A8.1(c)	07/03/2014	Pass
14	Occupied Bandwidth (OBW) – RSS-GEN, 4.6.1	07/03/2014	Pass
15	Tx AC Power Conducted Emissions – FCC 15.207 Covers RSS-GEN, 7.2.4	-----	Note 1

Notes:

1) The product is internal battery-powered – therefore, ac conducted emissions do not apply.

General Radio Remarks:

Testing was performed in 3 different orthogonal axes to determine the worst-case emissions from the device. The worst-case axis and emissions are shown in this report.

FCC CFR47 Part 15.31: Measurement Standards: In any case where the device is powered off a battery, a fresh battery was used during testing.

FCC CFR Part 15.35: Measurement Detector Functions and Bandwidths: FCC Part 15.35 was utilized when performing measurements within this report.

ANSI C63.10, Section 4.2.3.2.2/ FCC 15.35(b): When an average limit is specified, the peak emission must also be measured to ensure the emissions is less than 20dB above the average limit and/or below the peak limit specified. This report includes both average and peak test data.

ANSI C63.10, Section 4.2.3.2.4/ FCC 15.35(c): When the field strength (or envelope power) is not constant or when it pulses, and an average detector/limit is specified to be used, a duty cycle correction factor may be utilized to determine the pulsed "average" of the field strength or power.
Duty cycle correction was utilized in this report for emissions > 1GHz.

Whenever possible, the approved test procedures specified in FCC DA 00-705 for FHSS (Frequency Hopping Spread Spectrum) devices was used for testing.

The product tested was configured with an integral antenna – therefore all measurements are radiated field strength measurements. If antenna conducted port tests cannot be performed, radiated field strength measurements may be taken to demonstrate compliance with the various conducted port power requirements of FCC 15.247.

2.1 Test Facility

Intertek Denver's testing facilities are located at 1795 Dogwood St. Suite 200 Louisville, CO 80027.
The testing facility is ISO17025:2005 accredited by A2LA, our lab code is 2506.02, our VCCI registration numbers are: R-1643, C-1752 and T-1558, our FCC designation no. US1121 and our IC lab no. 2042N.

Testing contained in this test report may not be covered under the laboratories scope of accreditation.
A note will be placed in the specific test section for testing not coved under the laboratories scope.

3 Description of Equipment Under Test

3.1 Product – General Information Summary

Model:	EN1221S-60
Type of EUT:	Frequency-Hopping Spread-Spectrum (FHHS)
Serial Number:	FCC1
FCC ID:	HCQ3B64X9RUX
Industry Canada ID:	2309A-4X9RUX
Related Submittal(s) Grants:	Not applicable
Company:	Innovonics Wireless Corporation
Customer:	Innovonics Wireless Corporation
Address:	397 South Taylor Avenue, Louisville, CO 80027
Phone:	(303) 209-7143
Fax:	(303) 209-8977
e-mail:	cleavitt@inovonics.com
Test Standards:	☒ 47 CFR, Part 15C:§15.247 FHSS ☒ RSS–210, Issue 8, 2010 ☒ RSS-Gen, Issue 3, 2010 ☐ 47 CFR, Part 15C:§15.207 ☒ 47 CFR, Part 15, §15.107 and §15.109, Class B ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	07/02/2014
Test Work Started:	07/03/2014
Test Work Completed:	07/03/2014
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good

Product Description:	Pendant – EN 1221S-60
Transmitter Type:	☒ FHSS ☐ Digital Modulation ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	Range: 902.40 to 927.60 MHz
Number of Channels:	25 – Channels
Modulation:	FSK
Antenna Info:	Integral Antenna (Gain: Unknown)
EUT Power settings:	17.0-18.0 dBm 50-75mW
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☒ 3VDC Internal Battery ☐ External power source ☐ 120VAC ☐ 230VAC ☐ VDC ☐ Other: ☐ ☐ 50Hz ☐ 60Hz
Special Test Arrangement:	As a hand-held device the EUT was rotated through three orthogonal axes to determine worst-case maximum radiated emissions
Test Facility Accreditation:	A2LA (Certificate No. 2506.02)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10: 2013 (Guidance FCC Public Notice DA 00-705: 2000)

3.2 Product – Detailed Information Summary:

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Pendant	Inovonics Wireless	EN1221S-60	FCC1

Receive Date:	07/02/2014
Received Condition:	Good
Type:	Production Sample

Description of Equipment Under Test (provided by client)
The product is a hand-held “Pendant” transmitter utilizing the 902-928MHz Tx Band. Product transmit range: 902.4MHz to 927.6 MHz, 25-channels, FHSS Modulation: FSK Enclosure: Plastic Power: 3VDC Internal Battery

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
(Internal Battery Only) 3VDC CR123A Lithium	unknown	---	---

Operating modes of the EUT: Intentional Tx Testing

No.	Descriptions of EUT Exercising
1	EUT shall be powered by an internal battery, energized as intended & programmed to transmit continuously at one of three channel frequencies, low (902.4MHz), center (915.2MHz) and high (927.6MHz). Product modulation could be enabled or disabled as needed.
2	EUT set up in normal FHSS mode of operation, hopping on all 25 channels.

Operating modes of the EUT: Unintentional Idle/Standby Testing

No.	Descriptions of EUT Exercising
1	EUT shall be powered by an internal battery, energized as intended & programmed to operate in idle/standby mode of operation.

Clock Frequencies of the EUT:

No.	Descriptions of EUT Exercising
1	32.768kHz – micro-controller clock.
2	30.0MHz – radio clock frequency
3	2MHz ~ 3MHz switching regulator for power amplifier (PA) circuit.

3.3 Product Photo:

Product Tested – Model: EN1221S-60

External Photo

Internal Photo

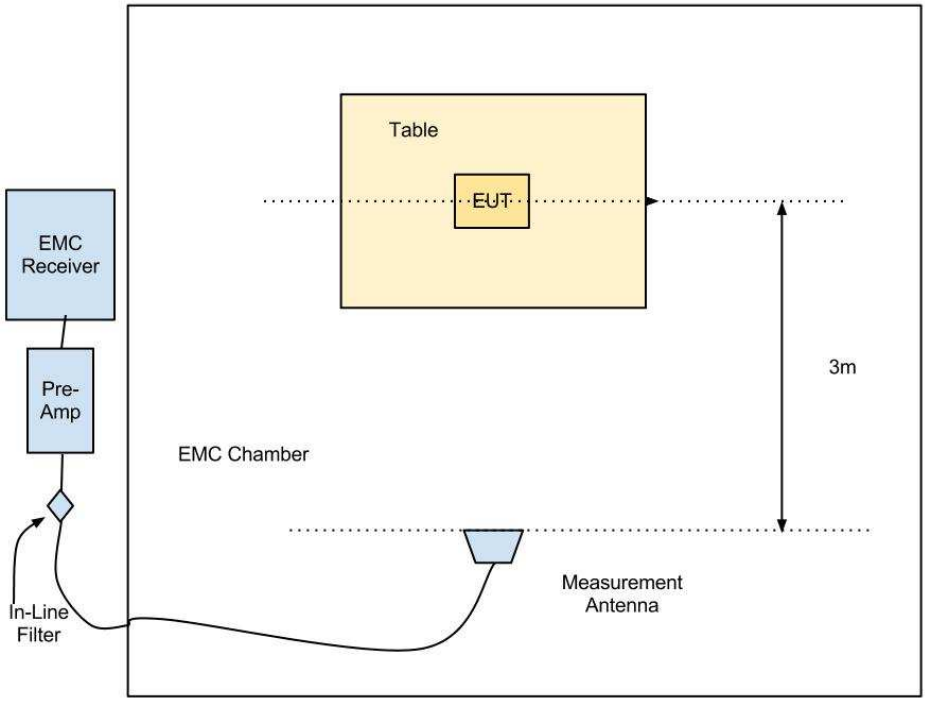
4 System setup including cable interconnection details, support equipment and simplified block diagram

4.1 Method:

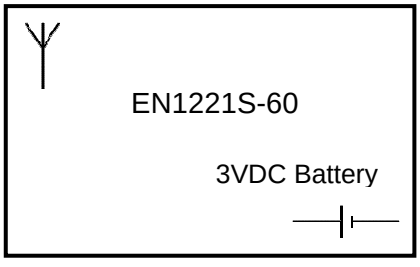
The EUT is a stand-alone device powered by an internal battery. No external support cables are necessary for normal operation.

4.2 EUT Block Diagram:

Top View – Radiated Emissions Chamber



EUT



4.3 Support Data:

ID	Description/ Function	Shield Type	Length	Connector	Connection	Ferrites
---	---	---	---	---	---	---

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop Computer	Dell	---	---

General notes:
1. Product has no I/O or signal cables.
2. Product did not require any support equipment other than laptop computer to configure Tx settings.

5 Radiated Emissions – Intentional Radiators: Output Power – Tx Fundamental – FCC 15.247(b)(2)

5.1 Method

Unless otherwise stated no deviations were made from ANSI C63.10 and FCC public notice DA 00-705.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

- FCC 15.247(b)(2)
- RSS-210, A8.4(1)

5.2 Specification:

- FCC DA 00-705 FHHS Measurement Guidance: 2000, Section “Peak Output Power” (RBW > 20dB BW, Peak Detector)
- Specification: Maximum Peak Conducted Output Power 0.25 W and E.I.R.P. 1.0W (119.2 dBuV/m @ 3-meters worst-case, assumes antenna gain 0dBi)

5.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/13/2013	11/13/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

5.4 Results:

The sample tested was found to Comply.

5.5 Results Summary:

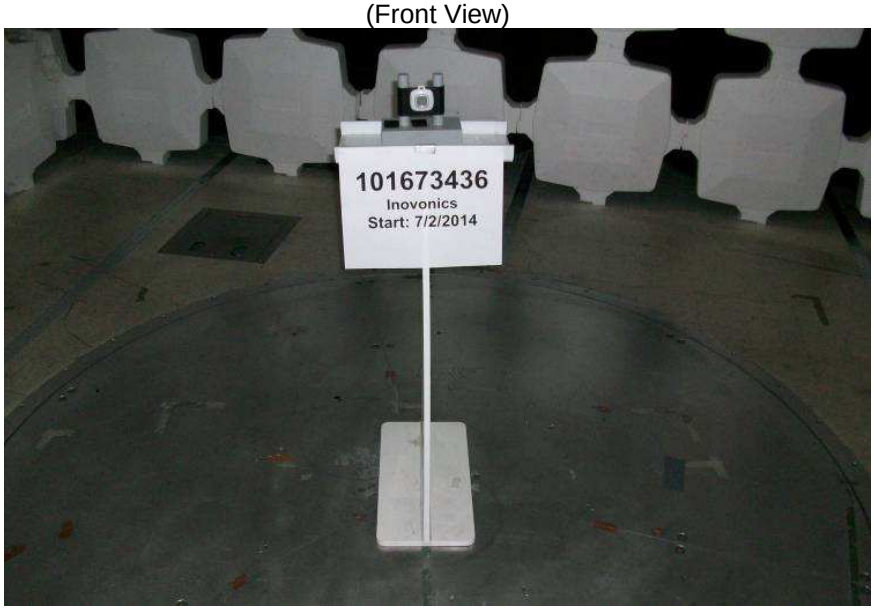
Tx Channel	Frequency (MHz)	Final Radiated Field Strength (dBuV/m)	Radiated Field Strength Limit (dBuV/m)	Margin (dB)	Result
Lowest	902.40	105.96	119.2	-13.24	Pass
Middle	915.20	107.88	119.2	-11.32	Pass
Highest	927.60	106.32	119.2	-12.88	Pass

Note: The limit of 119.2 dBuV/m at 3-meter product-to-antenna distance assumes antenna gain of 0dBi – worst case.

5.6 Setup Photographs:

Test Setup – Tx Fundamental Output

(Front View)



(Rear View)

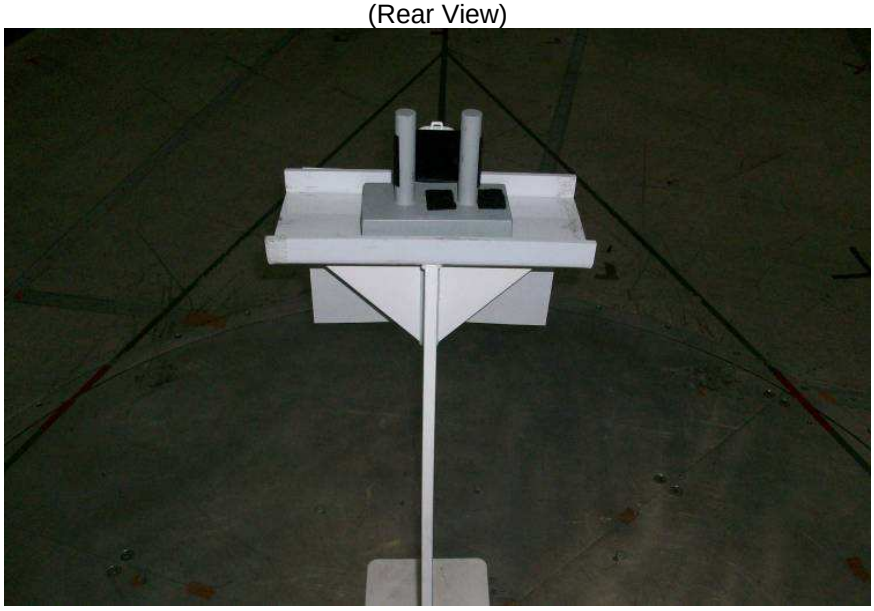


Photo:

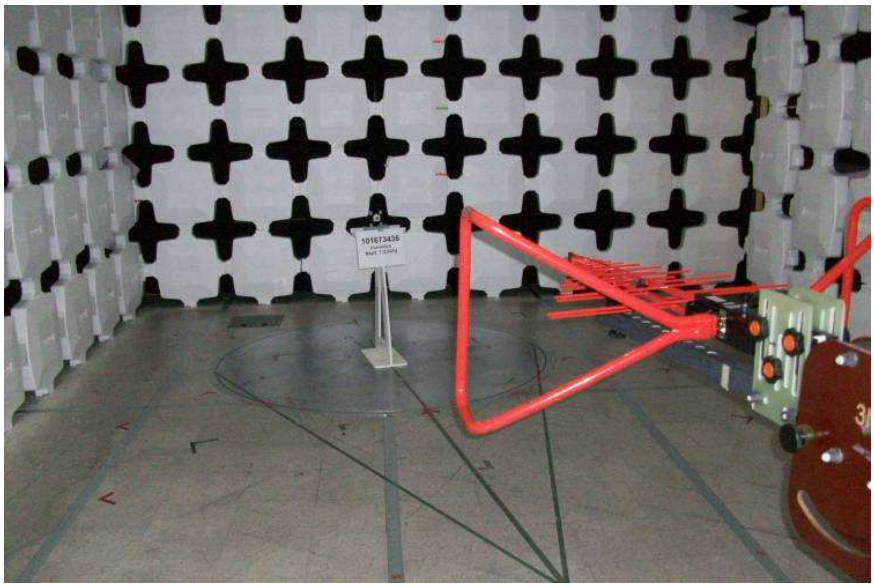
Product Test Axis 1 (Flat on Table)

Product Test Axis 2 (Vertical)

Product Test Axis 3 (Vertical & Rotated 90º)

Photo:

Antenna Setup (30-1000 MHz)



5.7 Test Data: Fundamental Peak Output Power

Fundamental Peak Output Power of the Transmitter

Test Report #:	**G101673436**	Test Area:	CC1 Radiated	Temperature:	22.9	°C
Test Method:	FCC 15.247 FHSS	Test Date:	02-Jul-2014	Relative Humidity:	20.5	%
EUT Model #:	EN1221S-60	EUT Power:	3VDC Internal Battery	Air Pressure:	83.1	kPa
EUT Serial #:	FCC1					
Manufacturer:	Inovonics Wireless					
EUT Description:	Pendant					

Notes: Product transmitting continuously – worst-case modulation

(3) Test Axes measured; Lowest, Middle and Highest Channels measured

RF Radiated Field Measurements @ 3-meters, Peak detector max hold, RBW = 1MHz, VBW = 3MHz

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

The following Duty Cycle was verified by Intertek: Not applicable for fundamental < 1GHz

Radiated Field Strength Limit based upon worst-case antenna gain of 0dBi

Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.

The testing performed in accordance to FCC CFR47 Part 15.247 and delta limits were calculated as follows:

Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission

The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.247 and the emission/limit delta was calculated.

DTCF is calculated as follows $20*\log_{10}$ (duty cycle in 100mS**).**

Part 15.247 FHHS

FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
[MHz]	[dBuV/m]	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV/m]	[dB]	FINAL	(V/H)	(m)	(DEG)	FCC 15.247 (b)(2) [dBuV/m]	[dB]	(MHz)
Fundamental Measurements – RF Radiated Field [dBuV/m]														
Tx Lowest Channel														
Axis 1 – Product Flat on Table														
902.4000	81.46	**Pk**	2.10	22.40	0.00	105.96	0.00	105.96	H	1.56	152.4	119.20	- 13.24	1.000
902.4000	73.85	**Pk**	2.10	22.40	0.00	98.35	0.00	98.35	V	1.54	229.4	119.20	- 20.85	1.000
Axis 2 – Product Vertical														
902.4000	77.95	**Pk**	2.10	22.40	0.00	102.45	0.00	102.45	V	1.32	242.8	119.20	- 16.75	1.000
902.4000	76.75	**Pk**	2.10	22.40	0.00	101.25	0.00	101.25	H	1.41	198.0	119.20	- 17.95	1.000
Axis 3 – Product Vertical & Rotated 90 degrees														
902.4000	78.04	**Pk**	2.10	22.40	0.00	102.54	0.00	102.54	H	1.38	359.9	119.20	- 16.66	1.000
902.4000	78.49	**Pk**	2.10	22.40	0.00	102.99	0.00	102.99	V	1.20	124.2	119.20	- 16.21	1.000
Tx Mid Channel														
Axis 1 – Product Flat on Table														
915.2000	75.15	**Pk**	2.11	22.40	0.00	99.66	0.00	99.66	V	1.62	228.7	119.20	- 19.54	1.000
915.2000	83.37	**Pk**	2.11	22.40	0.00	107.88	0.00	107.88	H	1.58	160.8	119.20	- 11.32	1.000

Axis 2 – Product Vertical														
915.2000	78.91	**Pk**	2.11	22.40	0.00	103.42	0.00	103.42	H	1.41	354.0	119.20	- 15.78	1.000
915.2000	79.37	**Pk**	2.11	22.40	0.00	103.88	0.00	103.88	V	1.24	192.4	119.20	- 15.32	1.000
Axis 3 – Product Vertical & Rotated 90 degrees														
915.2000	80.21	**Pk**	2.11	22.40	0.00	104.72	0.00	104.72	V	1.23	134.0	119.20	- 14.48	1.000
915.2000	80.06	**Pk**	2.11	22.40	0.00	104.57	0.00	104.57	V	1.28	125.8	119.20	- 14.63	1.000
Tx Highest Channel														
Axis 1 – Product Flat on Table														
927.6000	73.97	**Pk**	2.13	22.40	0.00	98.50	0.00	98.50	V	1.43	226.2	119.20	- 20.70	1.000
927.6000	81.79	**Pk**	2.13	22.40	0.00	106.32	0.00	106.32	H	1.61	156.2	119.20	- 12.88	1.000
Axis 2 – Product Vertical														
927.6000	78.25	**Pk**	2.13	22.40	0.00	102.78	0.00	102.78	H	1.48	218.7	119.20	- 16.42	1.000
927.6000	78.12	**Pk**	2.13	22.40	0.00	102.65	0.00	102.65	V	1.23	195.5	119.20	- 16.55	1.000
Axis 3 – Product Vertical & Rotated 90 degrees														
927.6000	78.45	**Pk**	2.13	22.40	0.00	102.98	0.00	102.98	V	1.33	115.5	119.20	- 16.22	1.000
927.6000	79.28	**Pk**	2.13	22.40	0.00	103.81	0.00	103.81	H	1.52	168.3	119.20	- 15.39	1.000

Notes:

1. All Fundamental and Harmonics measurements are RF Radiated Field – peak detector, max-hold measurements - 1MHz RBW (greater than the 20dB BW).

2. Fundamental measurements were not adjusted by a duty cycle correction factor (frequencies were less than 1GHz).

3. The device was measured at 3-meter measurement antenna-to-product test distance.

4. The device was placed on a turntable 80 cm high, it was rotated 360 degrees and the measurement antenna was raised and lowered between 1 and 4 meters to maximize emissions from this device.

Conversion of RF Port Output Power of the Fundamental Limit to Radiated Field Strength Limit
When limits are defined as conducted port power measurements and the product has an integral antenna, radiated field strength tests to demonstrate compliance are acceptable per FCC 15.247(b)(2).

The following equation was used to convert RF Port Power (Watts) limit into a Radiated Field Strength (dBuV/m) limit:

$$P\,[W] = \frac{(E * d)^2}{30G}$$

Therefore:

$$E\,[V/m] = \frac{\sqrt{(30PG)}}{d}$$

Power Limit Fundamental Frequency = 250mW => E = 119.2 dBuV/m
Where:
E = Measured Field Strength in V/m (converted to dBuV/m in test data)
P = 250mW Fundamental Limit
G = Numeric Gain of transmitting antenna over an ideal isotropic radiator = 1 (assumes worst case)
d = EUT-to-Antenna Test Distance = 3-meters

6 Radiated Emissions – Intentional Radiators: Tx Harmonics of the Fundamental – Includes Restricted Band - FCC 15.247(d)/ 15.209(a)/15.205

6.1 Method

Unless otherwise stated no deviations were made from ANSI C63.10 and FCC public notice DA 00-705.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

- FCC 15.247(d)/ 15.205/209(a)
- RSS-210, A8.5/ RSS-GEN, 7.2.2

6.2 Specification:

- In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
- Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).
- FCC 15.209(a)/ 15.205 (Restricted Band, QP ≤ 1GHz, Average > 1GHz)
- FCC 15.247(d) (Outside Restricted Band, 20dBc Peak/Average

6.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	05/21/2014	05/21/2015
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	05/23/2014	05/23/2015
DEN-032	4-18 GHz LNA	NARDA	DBL-0618N615	031	03/08/2014	03/08/2015
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/13/2013	11/13/2014
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/20/2014	03/20/2015
DEN-060	1GHz low Pass Filter	Mini-Circuits	VHF-1300+	3 1022	12/19/2013	12/19/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

6.4 Results:

The sample tested was found to Comply.

6.5 Results Summary:

Tx Channel	Frequency (MHz)	Final Radiated Field Strength Peak (dBuV/m)	Final Radiated Field Strength Average (dBuV/m)	Radiated Field Strength Limit Peak (dBuV/m)	Radiated Field Strength Limit Average (dBuV/m)	Limit Margin Peak (dB)	Limit Margin Average (dB)	Result
Harmonics within FCC Restricted Band								
Lowest	5414.40	61.23	47.63	74.00	54.00	-12.74	-6.37	Pass
Harmonics outside FCC Restricted Band								
Highest	5565.60	61.04	47.44	85.54	65.54	-24.50	-18.10	Pass

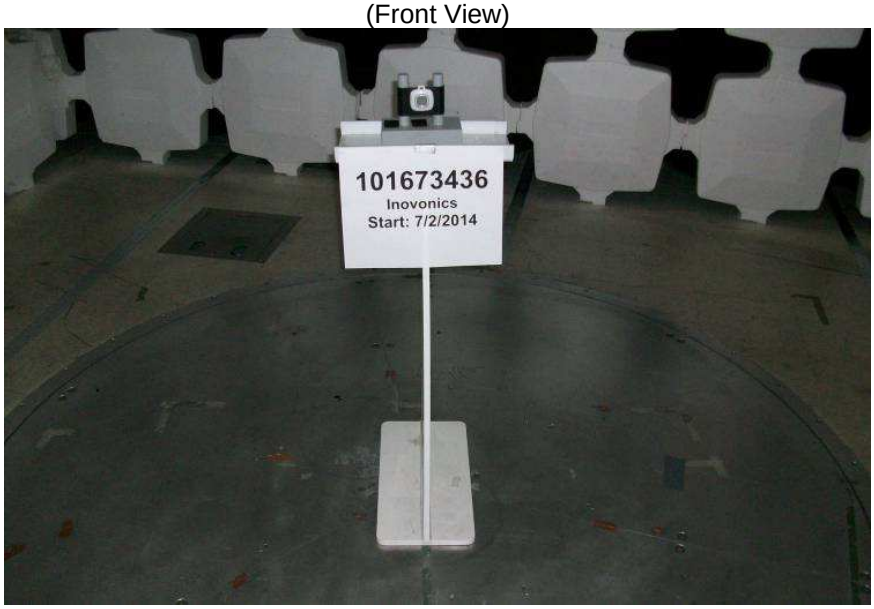
Note: Final Radiated Field Strength Average includes measured 13.6dB duty-cycle correction for pulsed emissions.

Note: Per FCC 15.35(b) – when an average limit is specified, there is also a peak limit that is 20dB above the average limit.

6.6 Setup Photographs:

Test Setup – Tx Spurious Harmonics of Fundamental

(Front View)



(Rear View)

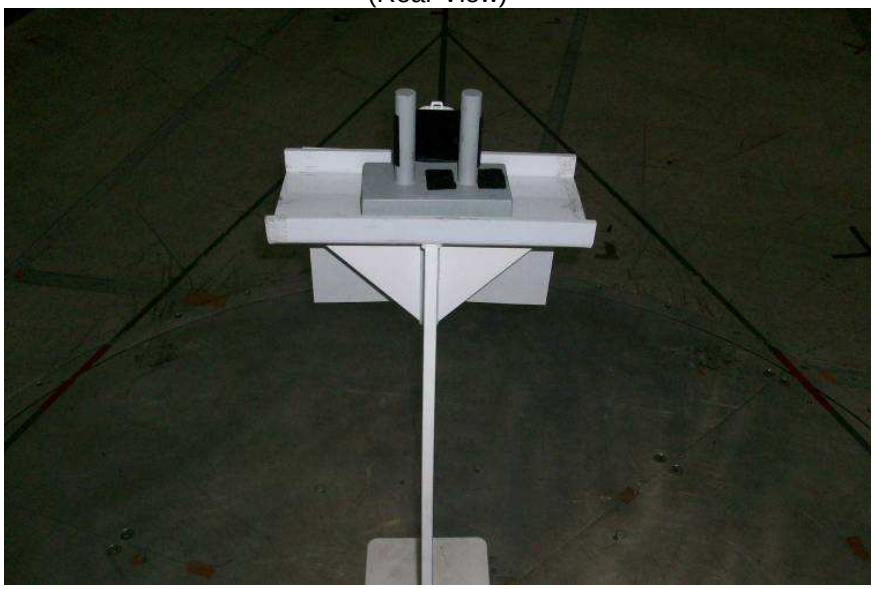
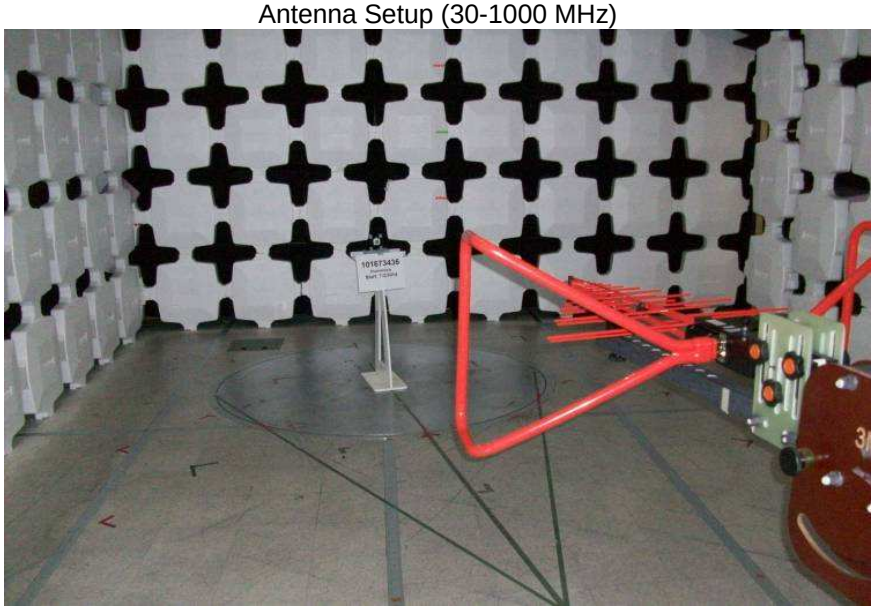
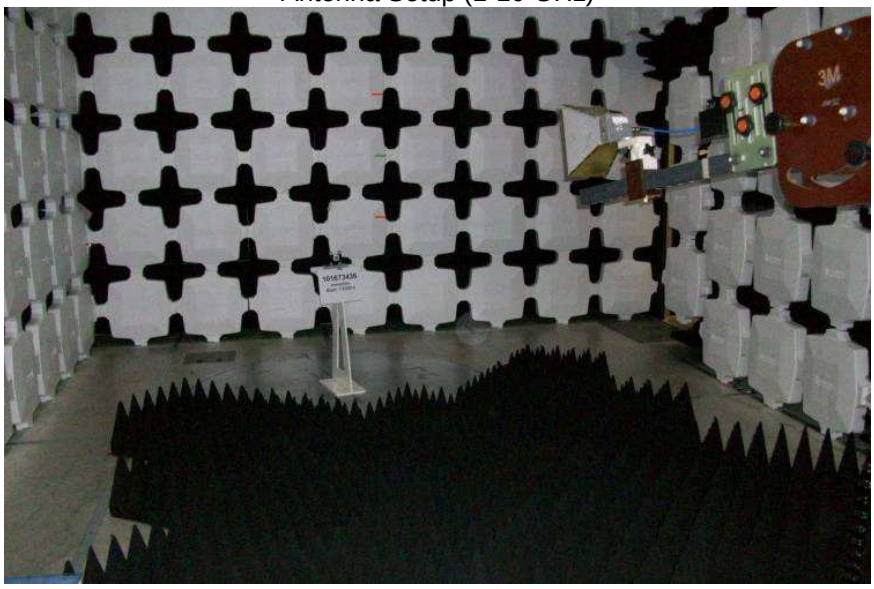


Photo:

Antenna Setup (30-1000 MHz)



Antenna Setup (1-10 GHz)



6.7 Test Data: Determination of Tx Spurious Limit – Outside Restricted Band

Tx Spurious Harmonics - Limit Determination

(Harmonics Outside Restricted Band)

Test Report #:	**G101673436**	Test Area:	CC1 Radiated	Temperature:	22.9 °C
Test Method:	FCC 15.247 FHSS	Test Date:	02-July-2014	Relative Humidity:	20.7 %
EUT Model #:	EN1221S-60	EUT Power:	3VDC Internal Battery	Air Pressure:	83.1 kPa
EUT Serial #:	FCC1				
Manufacturer:	Inovonics Wireless				
EUT Description:	Pendant				
Notes:	Product transmitting continuously – worst-case modulation.				
	(3) Test Axes measured; Lowest, Middle and Highest Channels measured				

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

RF Radiated Field Measurements @ 3-meters, Peak detector max hold,
RBW = 100kHz, VBW = 300kHz

Part 15.247 FHHS

FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
[MHz]	[dBuV/m]	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV/m]	[dB]	FINAL	(V/H)	(m)	(DEG)	FCC 15.247 (b)(2) [dBuV/m]	[dB]	(MHz)
Fundamental Measurements – RF Radiated Field [dBuV/m]														
Measurement using 100kHz RBW (300kHz VBW) to determine limits for the Harmonics of the Fundamental outside the FCC Restricted Band														
Tx Lowest Channel														
902.4000	80.57	Pk	2.10	22.40	0.00	105.07	0.00	105.07	H	1.56	152.4	N/A	N/A	0.100
Harmonic Low Channel Limit Outside Restricted Bands: 105.07dB - 20dB = **85.07**														
Tx Mid Channel														
915.2000	82.63	**Pk**	2.11	22.40	0.00	107.14	0.00	107.14	H	1.58	160.8	N/A	N/A	0.100
Harmonic Mid Channel Limit Outside Restricted Bands: 107.14dB - 20dB = **87.14**														
Tx Highest Channel														
927.6000	81.01	**Pk**	2.13	22.40	0.00	105.54	0.00	105.54	H	1.61	156.2	N/A	N/A	0.100
Harmonic High Channel Limit Outside Restricted Bands: 105.54dB - 20dB = **85.54**														

Note: The above measurements (using a 100kHz RBW) are only for determining the peak limits of the harmonics/spurious outside the restricted band.

6.8 Test Data: Spurious Harmonics of the Fundamental

Spurious Harmonics of the Transmitter

(Harmonics in FCC Restricted Band Denoted in Yellow Highlight)

Test Report #:	**G101673436**	Test Area:	CC1 Radiated	Temperature:	22.9 °C
Test Method:	FCC 15.247 FHSS	Test Date:	02-July-2014	Relative Humidity:	20.7 %
EUT Model #:	EN1221S-60	EUT Power:	3VDC Internal Battery	Air Pressure:	83.1 kPa
EUT Serial #:	FCC1				
Manufacturer:	Inovonics Wireless				
EUT Description:	Pendant				

Notes: Product transmitting continuously – worst-case modulation.

(3) Test Axes measured; Lowest, Middle and Highest Channels measured

RF Radiated Field Measurements @ 3-meters, Peak detector max hold,
RBW = 1MHz, VBW = 3MHz

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
MHz	dBuV/m	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV/m]	[dB]	FINAL dBuV/m	(V/H)	(m)	(DEG)	FCC 15.247 (b)(3) [dBuV/m]	[dB]	(MHz)
Harmonics (Spurious) of the Fundamental Measurements – RF Radiated Field [dBuV/m]														
Tx Lowest Channel														
1804.8000	53.58	**Pk**	3.02	26.80	37.06	46.33	13.6	32.73	H	1.49	309.7	85.07	- 52.34	1.000
1804.8000	55.02	**Pk**	3.02	26.80	37.06	47.77	13.6	34.14	V	1.67	5.2	85.07	- 50.93	1.000
2707.2000	55.08	**Pk**	3.76	28.97	37.47	50.34	13.6	36.71	H	2.01	173.0	54.00	- 17.29	1.000
2707.2000	58.06	**Pk**	3.76	28.97	37.47	53.32	13.6	39.69	V	1.67	282.9	54.00	- 14.31	1.000
3609.6000	53.65	**Pk**	4.42	31.57	37.89	51.74	13.6	38.11	H	1.95	187.2	54.00	- 15.89	1.000
3609.6000	53.08	**Pk**	4.42	31.57	37.89	51.17	13.6	37.54	V	1.83	76.2	54.00	- 16.46	1.000
4512.0000	47.81	**Pk**	4.99	32.52	37.57	47.75	13.6	34.12	H	1.40	143.3	54.00	- 19.88	1.000
4512.0000	51.96	**Pk**	4.99	32.52	37.57	51.90	13.6	38.27	V	1.67	289.0	54.00	- 15.73	1.000
5414.4000	**64.84**	**Pk**	**5.48**	**34.24**	**43.30**	**61.26**	**13.6**	**47.63**	**H**	**1.65**	**105.1**	**54.00**	**- 6.37**	**1.000**
5414.4000	64.50	**Pk**	5.48	34.24	43.30	60.92	13.6	47.29	V	1.55	179.9	54.00	- 6.71	1.000
6316.8000	55.05	**Pk**	5.95	34.92	46.14	49.78	13.6	36.15	H	1.64	289.9	85.07	- 48.92	1.000
6316.8000	56.52	**Pk**	5.95	34.92	46.14	51.25	13.6	37.62	V	1.40	329.5	85.07	- 47.45	1.000
7219.2000	54.45	**Pk**	6.41	36.09	47.43	49.52	13.6	35.89	H	1.69	86.6	85.07	- 49.18	1.000
7219.2000	56.12	**Pk**	6.41	36.09	47.43	51.19	13.6	37.56	V	1.51	306.4	85.07	- 47.51	1.000
8121.6000	52.74	**Pk**	6.89	37.05	46.42	50.26	13.6	36.63	H	1.68	128.8	54.00	- 17.37	1.000
8121.6000	53.18	**Pk**	6.89	37.05	46.42	50.70	13.6	37.07	V	1.57	265.4	54.00	- 16.93	1.000
9024.0000	52.24	**Pk**	7.34	38.37	47.38	50.57	13.6	36.94	H	1.68	128.8	54.00	- 17.06	1.000
9024.0000	49.40	**Pk**	7.34	38.37	47.38	47.73	13.6	34.10	V	1.57	81.6	54.00	- 19.90	1.000
Tx Mid Channel														
1830.4000	55.19	**Pk**	3.04	26.95	37.08	48.11	13.6	34.48	H	1.47	124.6	87.14	- 52.66	1.000
1830.4000	54.37	**Pk**	3.04	26.95	37.08	47.29	13.6	33.66	V	1.74	274.4	87.14	- 53.48	1.000
2745.6000	56.91	**Pk**	3.79	28.98	37.46	52.23	13.6	38.60	H	1.99	344.1	54.00	- 15.40	1.000

FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
MHz	dBuV/m	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV/m]	[dB]	FINAL dBuV/m	(V/H)	(m)	(DEG)	FCC 15.247 (b)(3) [dBuV/m]	[dB]	(MHz)
2745.6000	57.83	**Pk**	3.79	28.98	37.46	53.15	13.6	39.52	V	1.92	292.7	54.00	- 14.48	1.000
3660.8000	56.90	**Pk**	4.45	31.90	37.89	55.36	13.6	41.73	H	1.82	12.9	54.00	- 12.27	1.000
3660.8000	54.60	**Pk**	4.45	31.90	37.89	53.06	13.6	39.43	V	1.76	147.4	54.00	- 14.57	1.000
4576.0000	47.76	**Pk**	5.03	32.56	35.95	49.40	13.6	35.77	H	1.68	251.0	54.00	- 18.23	1.000
4576.0000	52.10	**Pk**	5.03	32.56	35.95	53.74	13.6	40.11	V	1.44	353.0	54.00	- 13.89	1.000
5491.2000	62.51	**Pk**	5.52	34.36	43.53	58.85	13.6	45.22	H	1.64	276.0	87.14	- 41.92	1.000
5491.2000	63.73	**Pk**	5.52	34.36	43.53	60.07	13.6	46.44	V	1.63	10.0	87.14	- 40.70	1.000
6406.4000	56.66	**Pk**	5.99	34.80	46.49	50.97	13.6	37.34	H	1.65	254.0	87.14	- 49.80	1.000
6406.4000	51.37	**Pk**	5.99	34.80	46.49	45.68	13.6	32.05	V	1.47	29.0	87.14	- 55.09	1.000
7321.6000	50.57	**Pk**	6.47	36.54	47.31	46.26	13.6	32.63	H	1.70	293.0	54.00	- 21.37	1.000
7321.6001	50.68	**Pk**	6.47	36.54	47.31	46.37	13.6	32.74	V	1.54	304.0	54.00	- 21.26	1.000
8236.7998	48.98	**Pk**	6.95	37.13	46.53	46.54	13.6	32.91	H	1.54	286.0	54.00	- 21.09	1.000
8236.8000	51.46	**Pk**	6.95	37.13	46.53	49.02	13.6	35.39	V	1.68	90.0	54.00	- 18.61	1.000
9152.0000	52.07	**Pk**	7.40	38.39	47.45	50.41	13.6	36.78	H	1.62	90.0	54.00	- 17.22	1.000
9152.0000	52.88	**Pk**	7.40	38.39	47.45	51.22	13.6	37.59	V	1.66	68.0	54.00	- 16.41	1.000
Tx Highest Channel														
1855.2000	53.58	**Pk**	3.07	27.09	37.09	46.66	13.6	33.03	H	1.42	159.7	85.54	- 52.51	1.000
1855.2000	54.02	**Pk**	3.07	27.09	37.09	47.10	13.6	33.47	V	1.70	185.2	85.54	- 52.07	1.000
2782.8000	55.62	**Pk**	3.82	29.00	37.51	50.94	13.6	37.31	H	1.63	175.1	54.00	- 16.69	1.000
2782.8000	56.51	**Pk**	3.82	29.00	37.51	51.83	13.6	38.20	V	1.47	301.3	54.00	- 15.80	1.000
3710.4000	56.10	**Pk**	4.48	32.22	37.80	55.00	13.6	41.37	H	1.74	52.0	54.00	- 12.63	1.000
3710.4000	55.73	**Pk**	4.48	32.22	37.80	54.63	13.6	41.00	V	1.36	173.7	54.00	- 13.00	1.000
4638.0000	49.16	**Pk**	5.07	32.63	36.58	50.28	13.6	36.65	H	1.80	39.0	54.00	- 17.35	1.000
4638.0000	49.25	**Pk**	5.07	32.63	36.58	50.37	13.6	36.74	V	1.38	5.0	54.00	- 17.26	1.000
5565.6000	63.83	**Pk**	5.56	34.28	43.73	59.94	13.6	46.31	H	1.75	300.0	85.54	- 39.23	1.000
5565.6000	**64.96**	**Pk**	**5.56**	**34.28**	**43.73**	**61.07**	**13.6**	**47.44**	**V**	**1.66**	**351.0**	**85.54**	**- 38.10**	**1.000**
6493.2000	55.95	**Pk**	6.04	34.78	46.77	50.00	13.6	36.37	H	1.66	298.0	85.54	- 49.17	1.000
6493.2000	55.62	**Pk**	6.04	34.78	46.77	49.67	13.6	36.04	V	1.78	11.0	85.54	- 49.50	1.000
7420.8000	52.85	**Pk**	6.52	36.68	47.17	48.88	13.6	35.25	H	1.67	318.0	54.00	- 18.75	1.000
7420.8000	53.05	**Pk**	6.52	36.68	47.17	49.08	13.6	35.45	V	1.78	297.0	54.00	- 18.55	1.000
8348.4000	51.28	**Pk**	7.01	37.31	46.63	48.96	13.6	35.33	H	1.56	86.0	54.00	- 18.67	1.000
8348.4000	52.67	**Pk**	7.01	37.31	46.63	50.35	13.6	36.72	V	1.48	350.0	54.00	- 17.28	1.000
9276.0000	53.36	**Pk**	7.46	38.50	47.51	51.81	13.6	38.18	H	1.52	252.0	85.54	- 47.36	1.000
9276.0000	52.67	**Pk**	7.46	38.50	47.51	51.12	13.6	37.49	V	1.39	290.0	85.54	- 48.05	1.000

Example calculation for Intentional Radiated Emissions:

Measured Level	**+**	**Transducer, Cable Loss Pre-Amplifier**	**=**	**Corrected Reading**	**-**	**Duty Cycle Correction**	**=**	**FINAL Measurement**	**-**	**Specification Limit**	**=**	**Delta from Specification Limit**
(dBµV)		(dB)		(dBµV/m)		(dBµV/m)		(dBµV/m)		(dBµV/m)		
24.0		**14.9**		**38.9**		**10.0**		**28.9**		**40.0**		**-11.1**

Notes:

1. All Fundamental and Harmonics measurements are RF Radiated Field – peak detector measurements - 1MHz RBW.
2. Measurements above 1GHz were adjusted by the allowed duty cycle correction factor per FCC 15.35(c)/ IC RSS-GEN, Section 4.5.
3. The device was measured at 3 meters measurement antenna-to-product test distance.
4. The device was placed on a turntable 80 cm high, it was rotated 360 degrees and the measurement antenna was raised and lowered between 1 and 4 meters to maximize emissions from this device.

Duty Cycle Correction Factor
DCCF is calculated as follows $20*\log_{10}$(duty cycle in 100mS) and is “not to exceed 20dB”.

The plots in section 13 (Dwell Time) show that the max duty cycle is 20.83 mS per 100mS period, yielding a 13.56 dB duty-cycle correction factor.

FCC Restricted Band Harmonics – Reference Only

fundamental		**Harmonics**								
MHz0	MHz1	MHz2	MHz3	MHz4	MHz5	MHz6	MHz7	MHz8	MHz9	MHz10
902.4	902.40	1804.80	2707.20	3609.60	4512.00	5414.40	6316.80	7219.20	8121.60	9024.00
915.2	915.20	1830.40	2745.60	3660.80	4576.00	5491.20	6406.40	7321.60	8236.80	9152.00
927.6	927.60	1855.20	2782.80	3710.40	4638.00	5565.60	6493.20	7420.80	8348.40	9276.00

7 Tx Band Edge & Restricted Band – FCC 15.247(d)/15.205(a)/15.209(a)

7.1 Method

Unless otherwise stated no deviations were made from ANSI C63.10 and FCC public notice DA 00-705.

This testing was performed at Intertek Denver, located at 1795 Dogwood St., Suite 200, Louisville, CO 80027.

- FCC 15.247(d)/ 15.205/209(a)
- RSS-210, A8.5/ RSS-GEN, 7.2.2

7.2 Specification:

- In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

- Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

7.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	05/21/2014	05/21/2015
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/13/2013	11/13/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

7.4 Results:

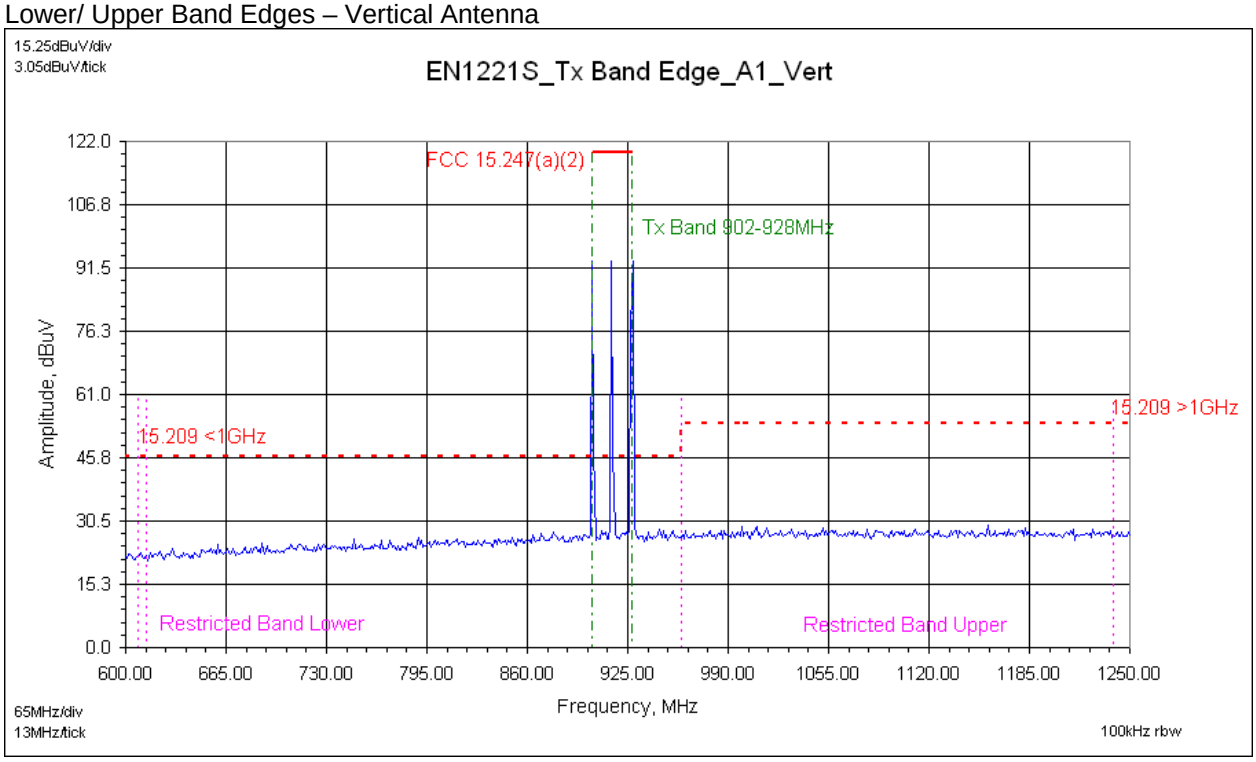
The sample tested was found to Comply.

7.5 Results Summary:

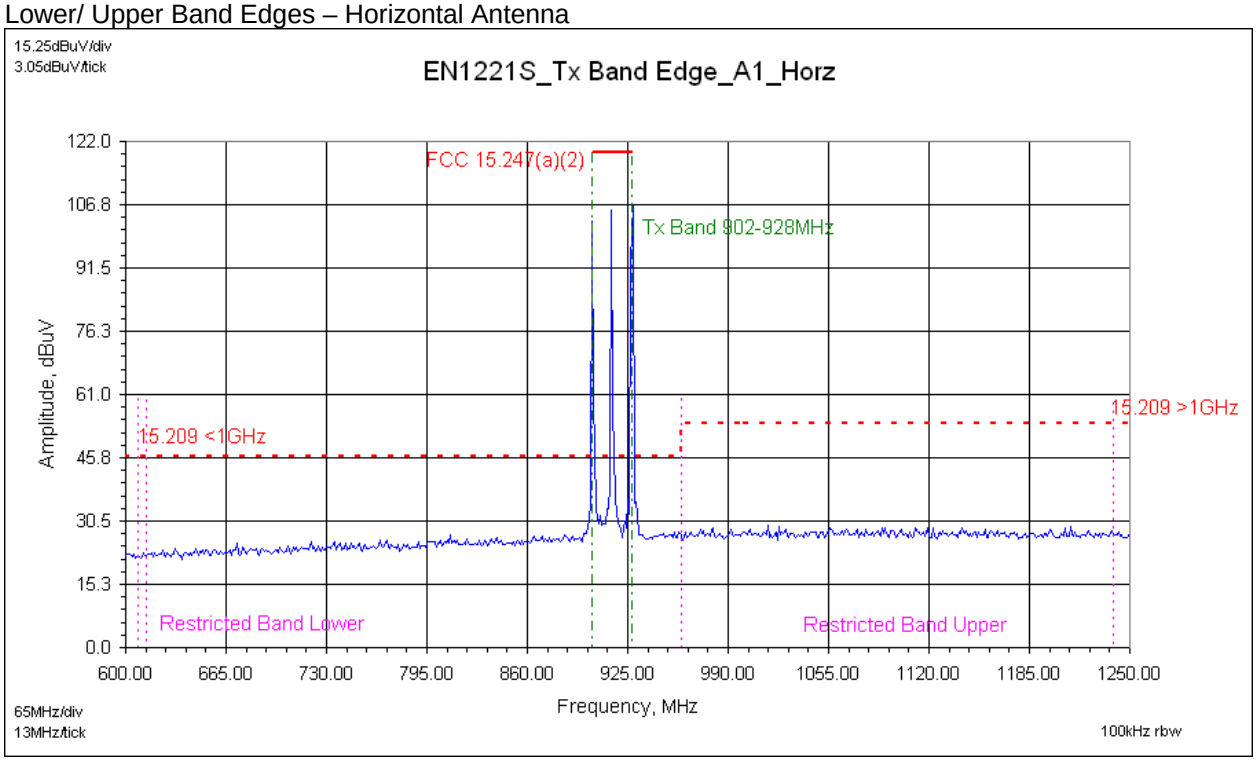
- All Tx Spurious signals within the FCC Restricted Bands were verified to be below the limits for FCC 15.205/209(a).
- All Tx Spurious signals up to 10GHz were > 20dBc.

7.6 Plots: Tx Spurious - Restricted Band

Lower/ Upper Band Edges – Vertical Antenna



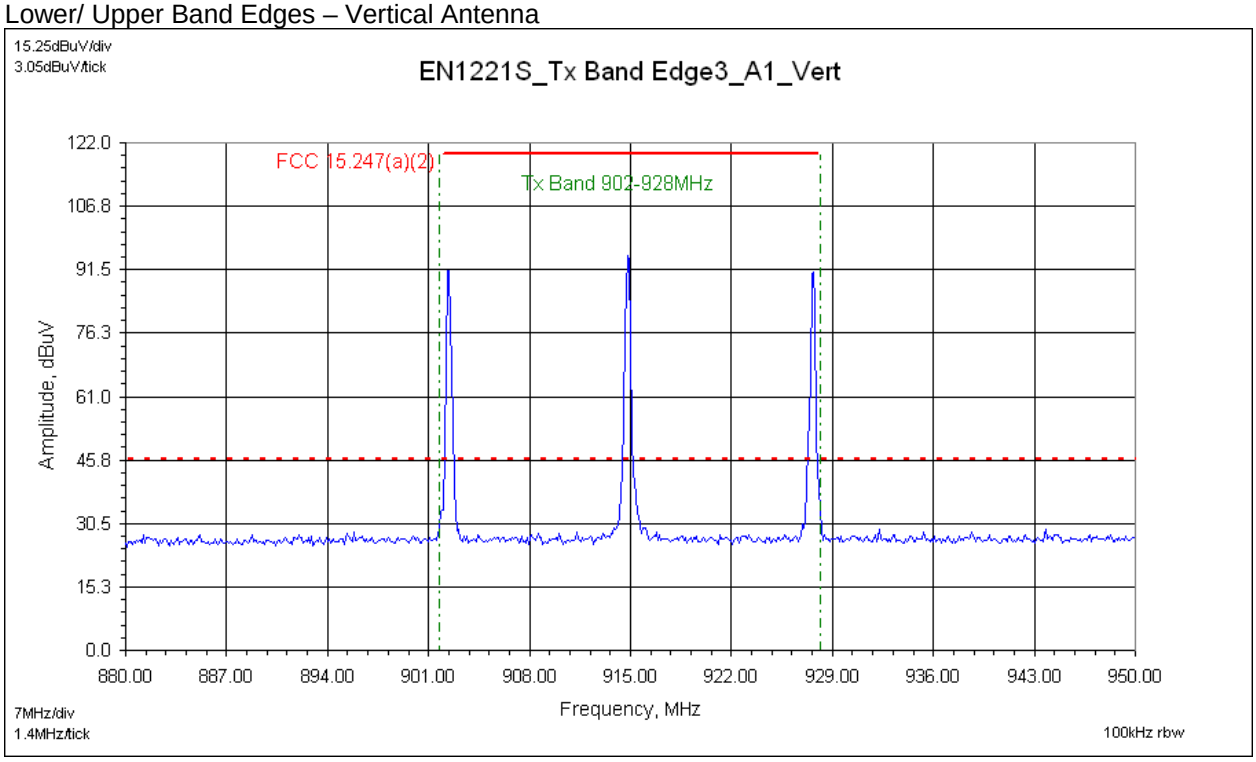
Lower/ Upper Band Edges – Horizontal Antenna



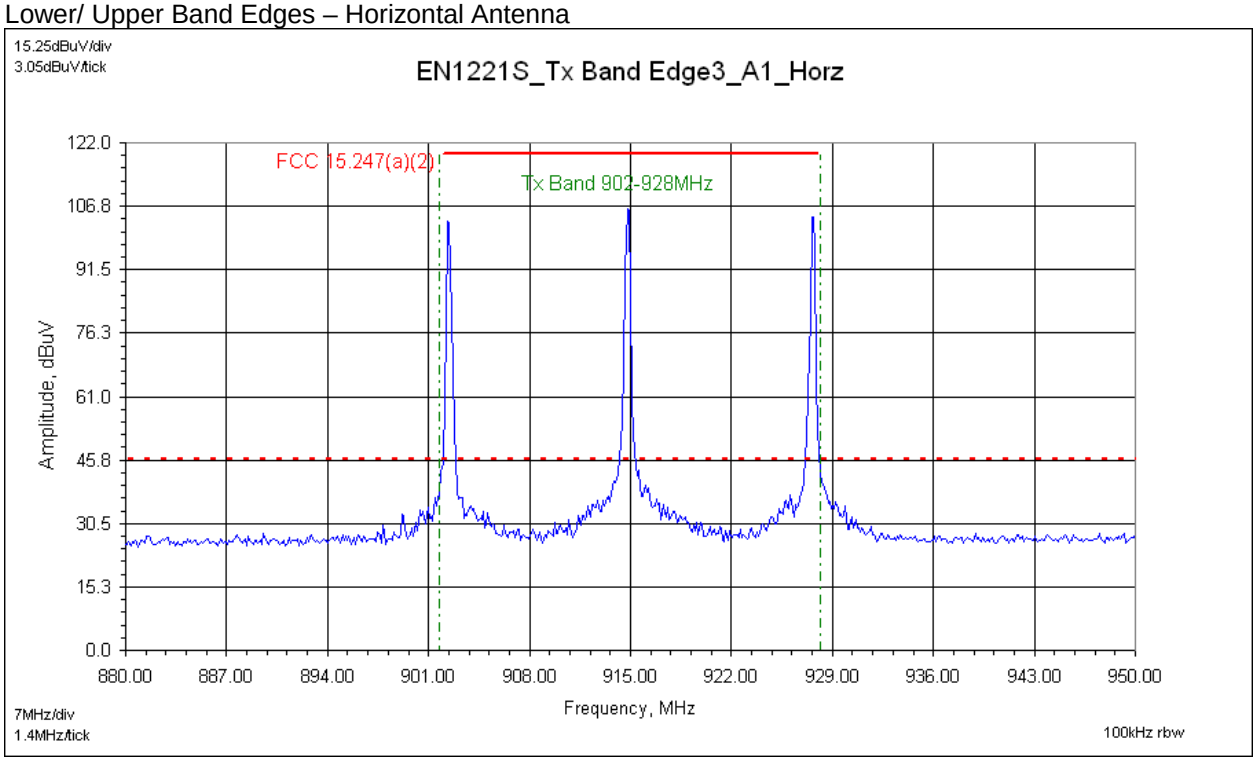
Peak detector, max-hold

7.7 Plots: Tx Spurious - Band Edge

Lower/ Upper Band Edges – Vertical Antenna



Lower/ Upper Band Edges – Horizontal Antenna



Peak detector, max-hold

7.8 Data: Band Edge

Band Edge - Radiated Electromagnetic Emissions

Test Report #:	G101673436	Test Area:	CC1 Radiated	Temperature:	23.8 °C
Test Method:	FCC 15.247(d)/ 15.209(a)	Test Date:	07/03/2014	Relative Humidity:	23.4 %
EUT Model #:	EN 1221S-60	EUT Power:	3VDC Internal Battery	Air Pressure:	83.5 kPa
EUT Serial #:	FCC1				
Manufacturer:	Inovonics Wireless				
EUT Description:	Pendant				

Notes: Product configured in Tx mode of operation, modulated signal.

Measurements taken both just inside and just outside the allowable Tx band.

Level Key
Pk – Peak
Qp – Quasi Peak
Av - Average

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	DEG	FCC 15.109	N/A	(MHz)
Measurements: Lower Band Edge													
901.9000	29.20	**Qp**	2.10	22.40	27.82	0.00	25.88	V	1.00	193.0	- 20.14	N/A	0.120
901.9000	39.65	**Qp**	2.10	22.40	27.82	0.00	36.33	H	1.84	170.0	- 9.69	N/A	0.120
902.0000	33.72	**Qp**	2.10	22.40	27.82	0.00	30.40	V	1.00	218.0	- 15.62	N/A	0.120
902.0000	41.14	**Qp**	2.10	22.40	27.82	0.00	37.82	H	1.65	184.0	- 8.20	N/A	0.120
Measurements: Upper Band Edge													
928.0000	34.20	**Qp**	2.13	22.40	27.76	0.00	30.97	V	1.00	191.0	- 15.05	N/A	0.120
928.0000	43.33	**Qp**	2.13	22.40	27.76	0.00	40.10	H	1.91	184.0	- 5.92	N/A	0.120
928.1000	30.19	**Qp**	2.13	22.40	27.76	0.00	26.96	V	1.00	260.0	- 19.06	N/A	0.120
928.1000	37.03	**Qp**	2.13	22.40	27.76	0.00	33.80	H	1.88	189.0	- 12.22	N/A	0.120

Example calculation:

Measured Level	+	Cable Loss	+	Antenna Factor	-	Pre-Amp	+	Atten	=	Final Corrected Reading	Specification Limit	-	Final Corrected Reading	=	Delta Specification
(dBµV)		(dB)		(dB)		(dB)		(dB)		(dBµV/m)	(dBµV/m)		(dBµV/m)		
20.0		**3.0**		**5.0**		**10.0**		**0.0**		**18.0**	**40.0**		**18.0**		**- 22.0**

Notes:

1) The device was measured at 3 meters measurement antenna-to-product test distance.
2) The device was placed on a turntable 80 cm high, it was rotated 360 degrees and the measurement antenna was raised and lowered between 1 and 4 meters to maximize emissions from this device.

8 Radiated Emissions Tx Spurious 20dBc (Harmonics & Non Harmonics)

8.1 Method

Unless otherwise stated no deviations were made from ANSI C63.10 and FCC public notice DA 00-705.

This testing was performed at Intertek Denver, located at 1795 Dogwood St., Suite 200, Louisville, CO 80027.

- FCC 15.247(d)/ 15.205/15.209(a)
- RSS-210, A8.5

8.2 Specification:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

8.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	05/21/2014	05/21/2015
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	05/23/2014	05/23/2015
DEN-032	4-18 GHz LNA	NARDA	DBL-0618N615	031	03/08/2014	03/08/2015
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/13/2013	11/13/2014
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/20/2014	03/20/2015
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

8.4 Results:

The sample tested was found to Comply.

8.5 Results Summary:

The following plots demonstrate that all Tx spurious signals (including harmonics) were at least 20dB lower - relative to the fundamental signal.

8.6 Setup Photographs:

Front View

Rear View

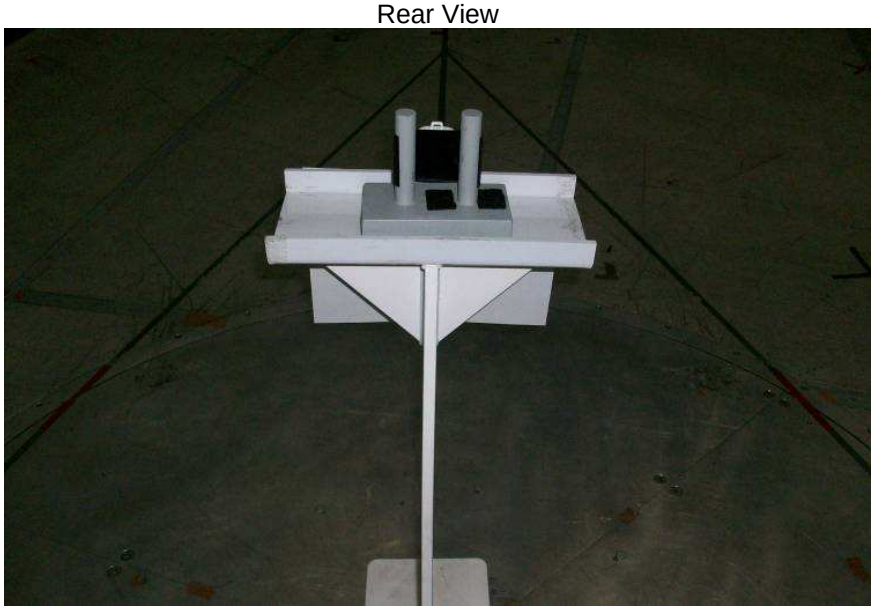
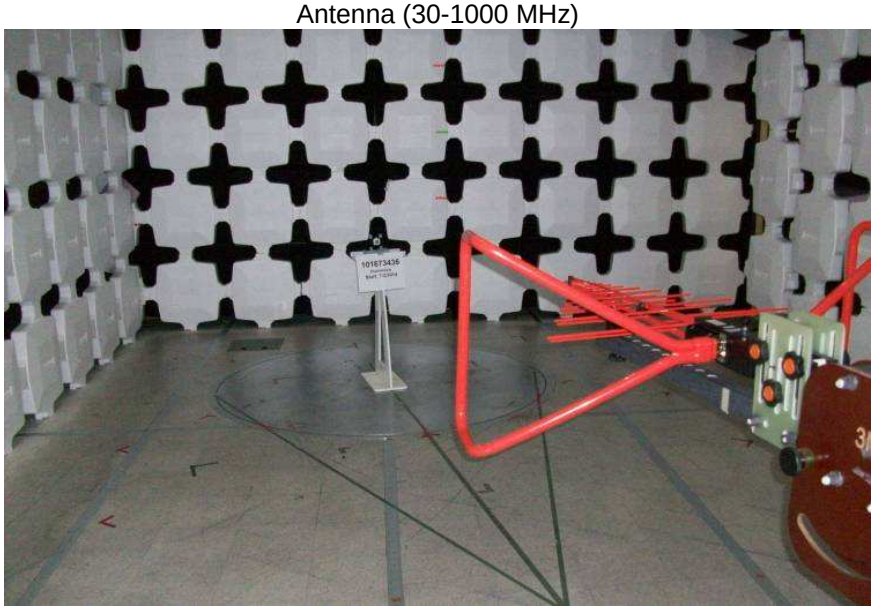
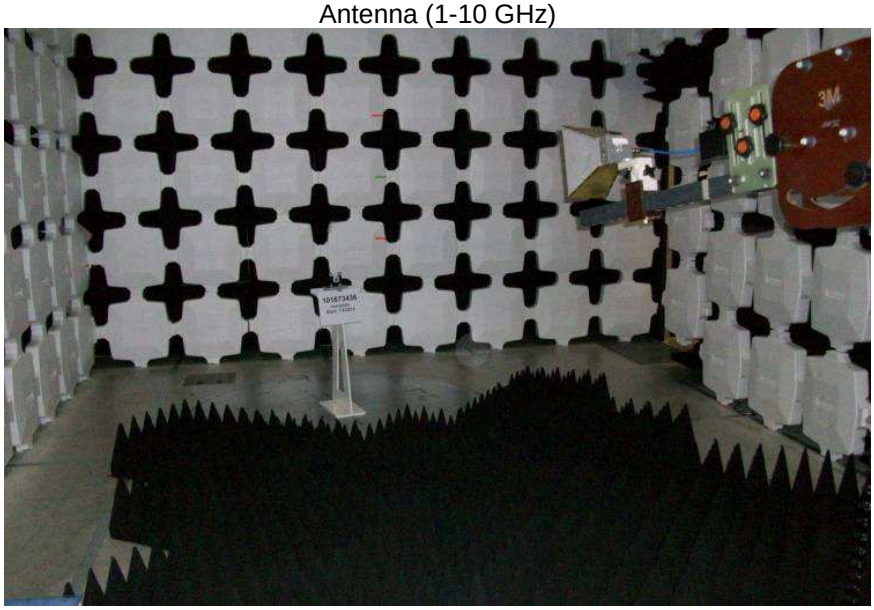


Photo:

Antenna (30-1000 MHz)



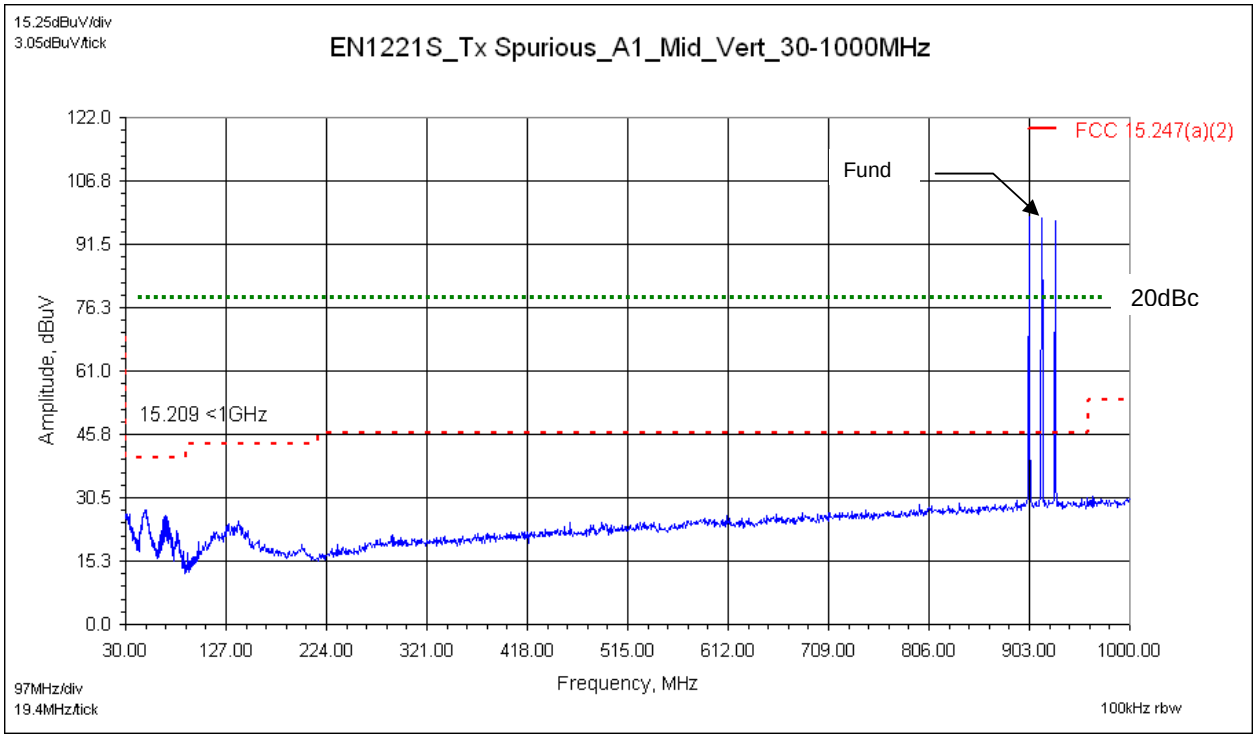
Antenna (1-10 GHz)



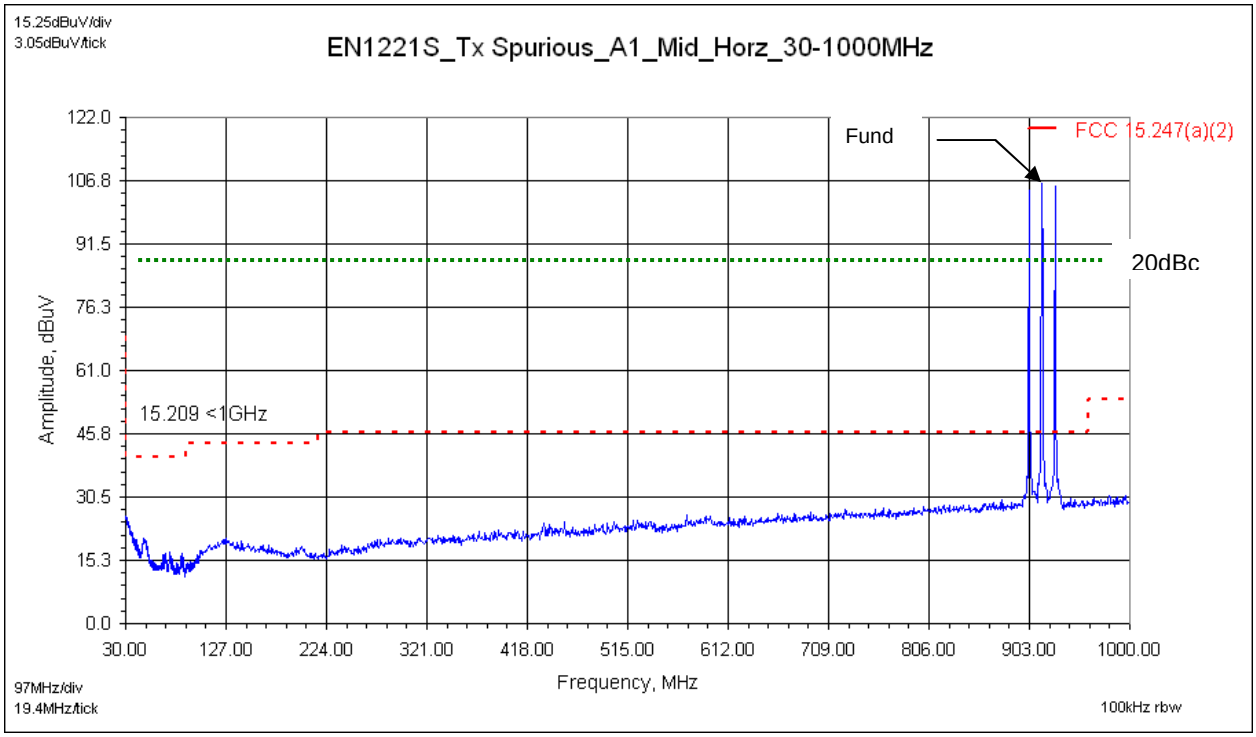
8.7 Pre-scan Plots: Low, Mid, High Channel – Axis 1

30MHz to 1000MHz

Vertical Antenna – Product Axis 1



Horizontal Antenna – Product Axis 1

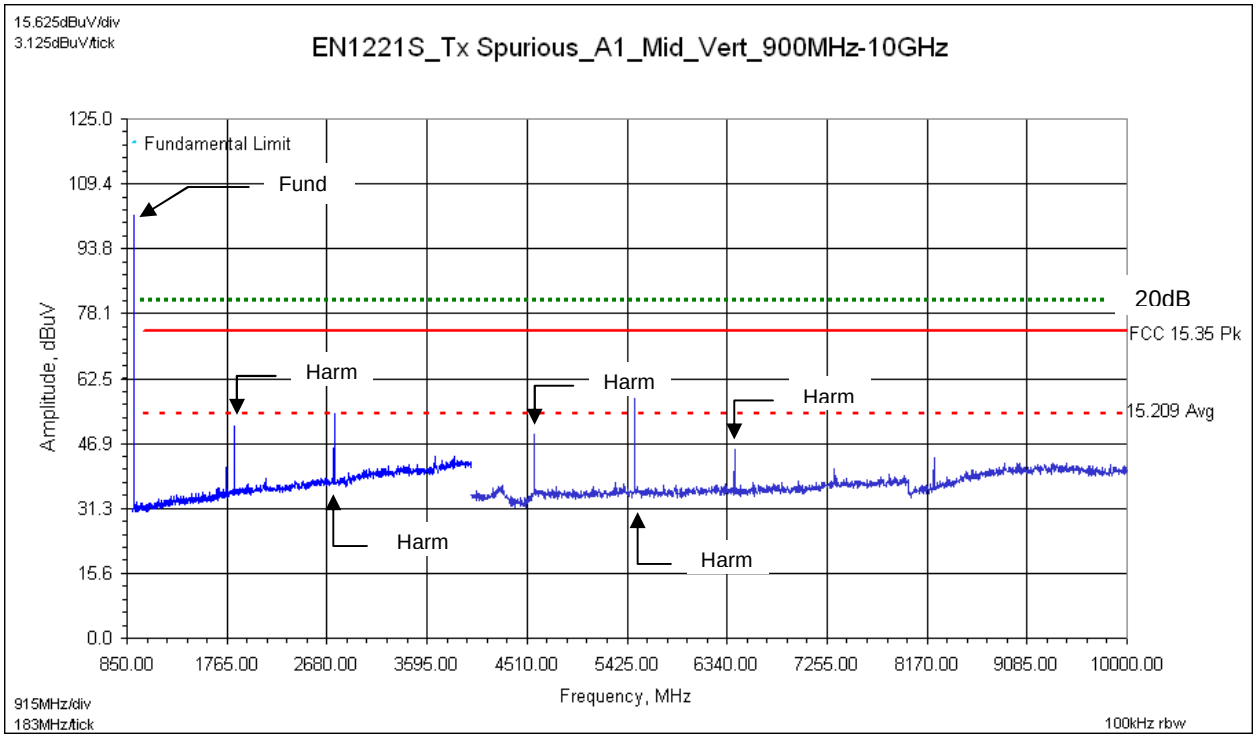


Peak detector, max-hold measurements

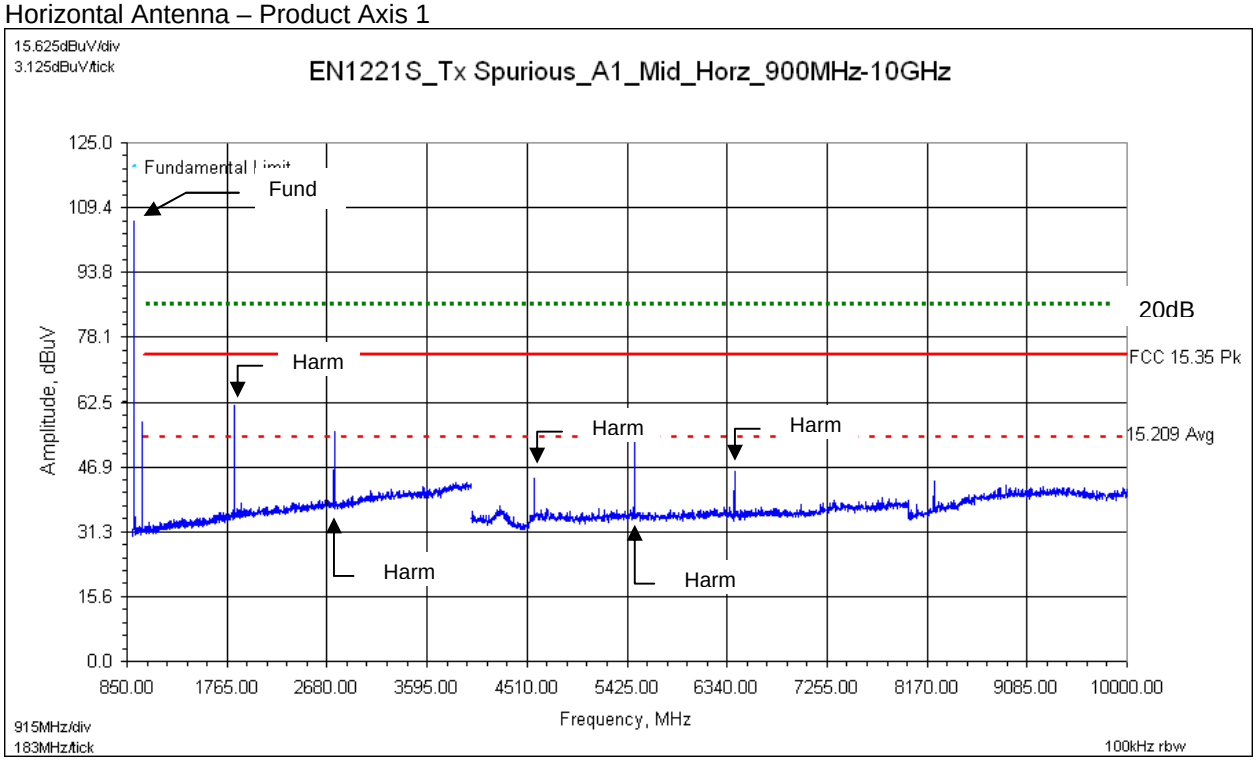
8.8 Pre-scan Plots: Mid Channel – Axis 1

1GHz to 10GHz

Vertical Antenna – Product Axis 1



Horizontal Antenna – Product Axis 1

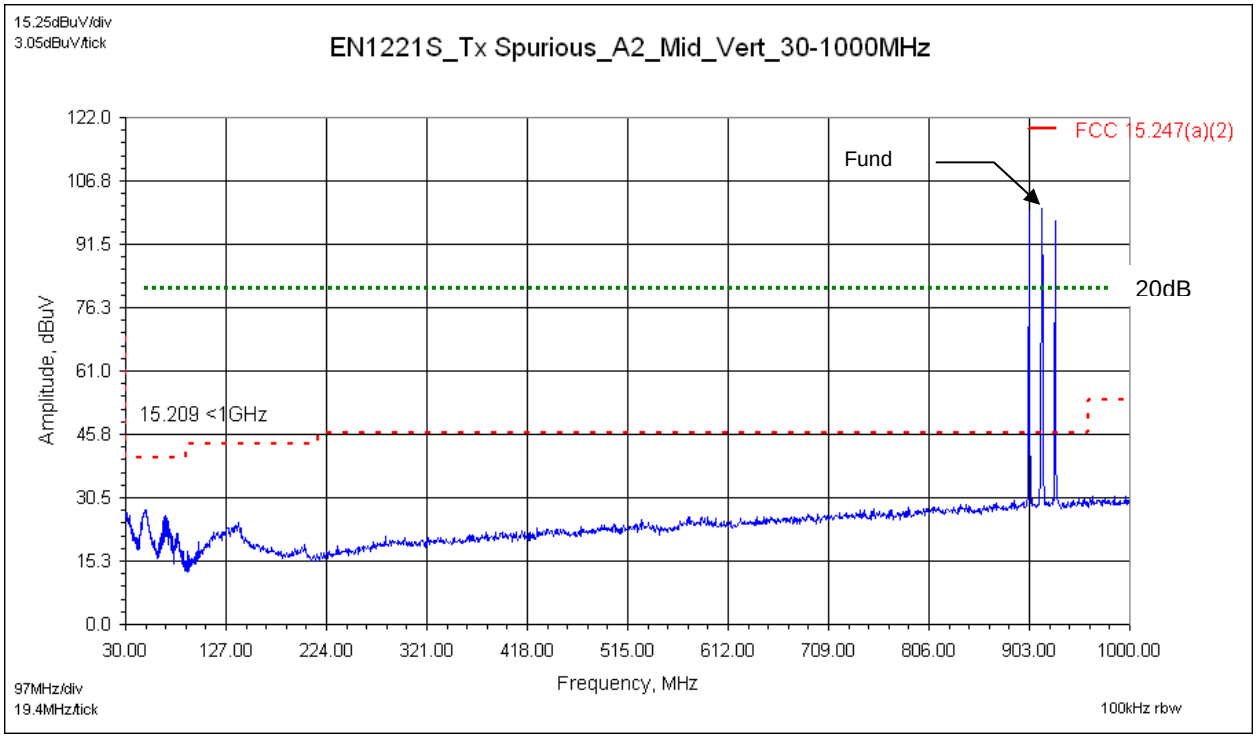


Peak detector, max-hold measurements

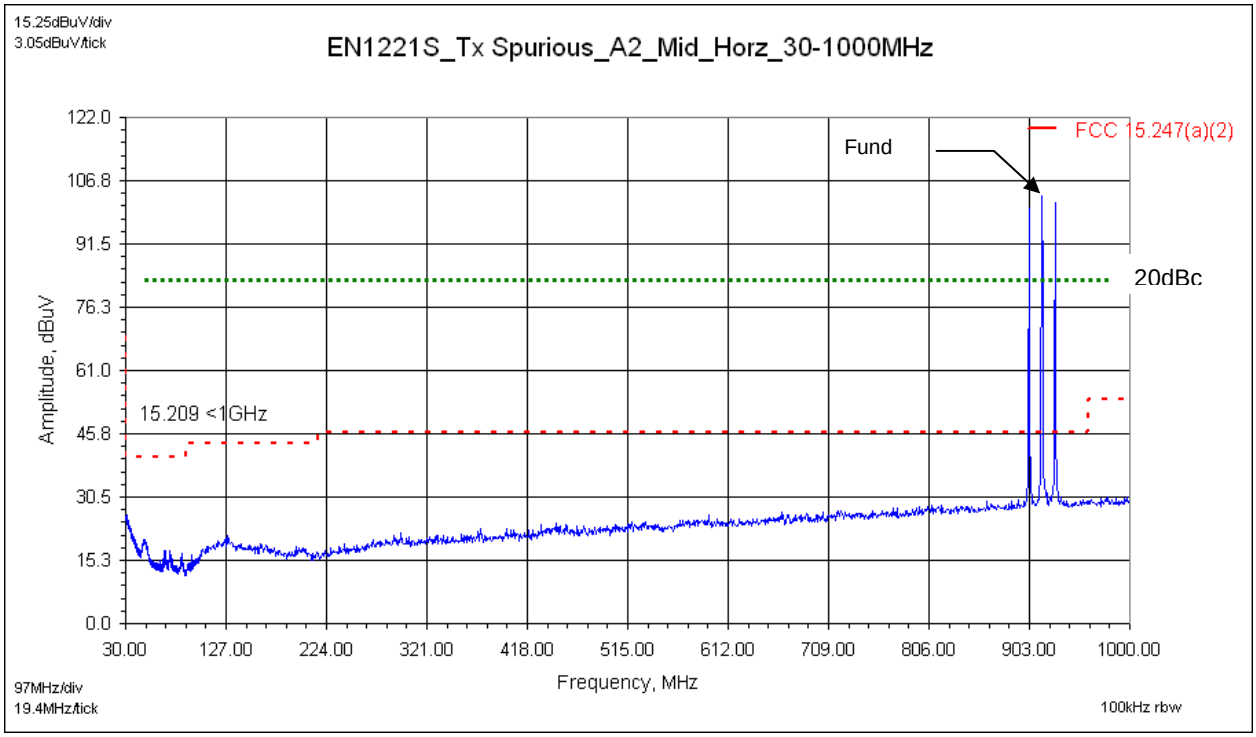
8.9 Pre-scan Plots: Low, Mid, High Channel – Axis 2

30MHz to 1000MHz

Vertical Antenna – Product Axis 2



Horizontal Antenna – Product Axis 2

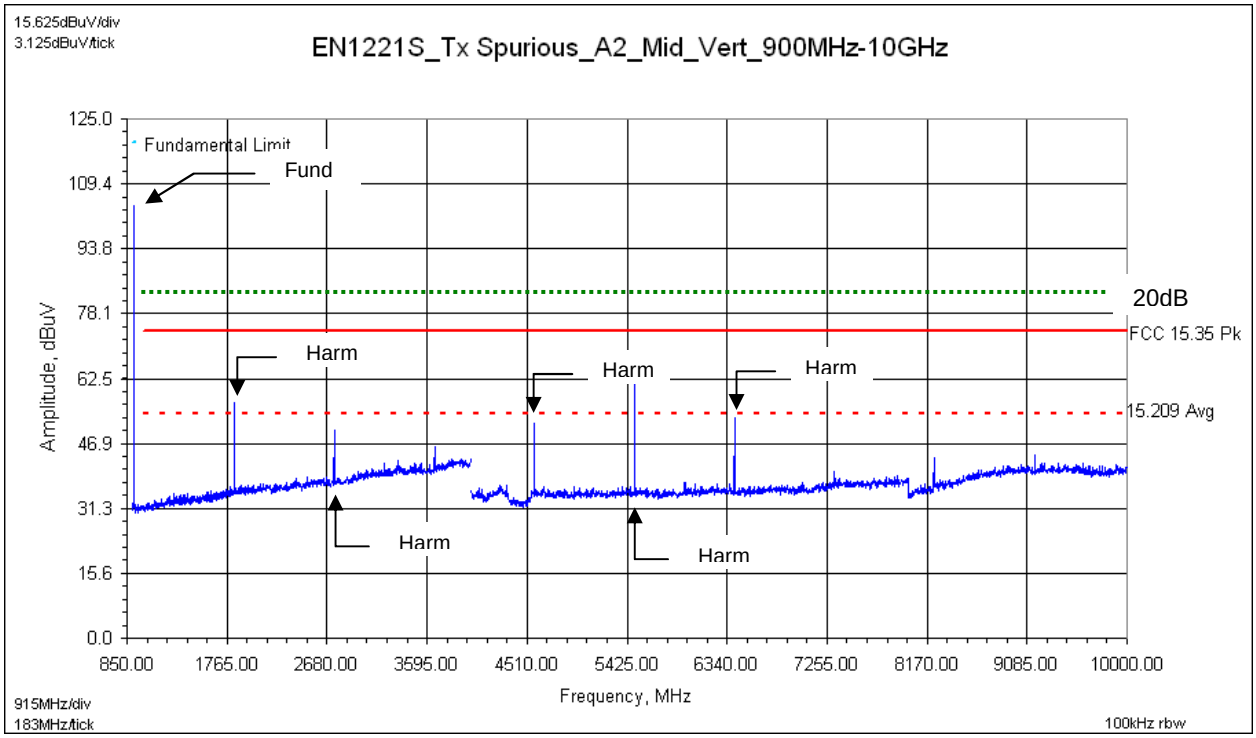


Peak detector, max-hold measurements

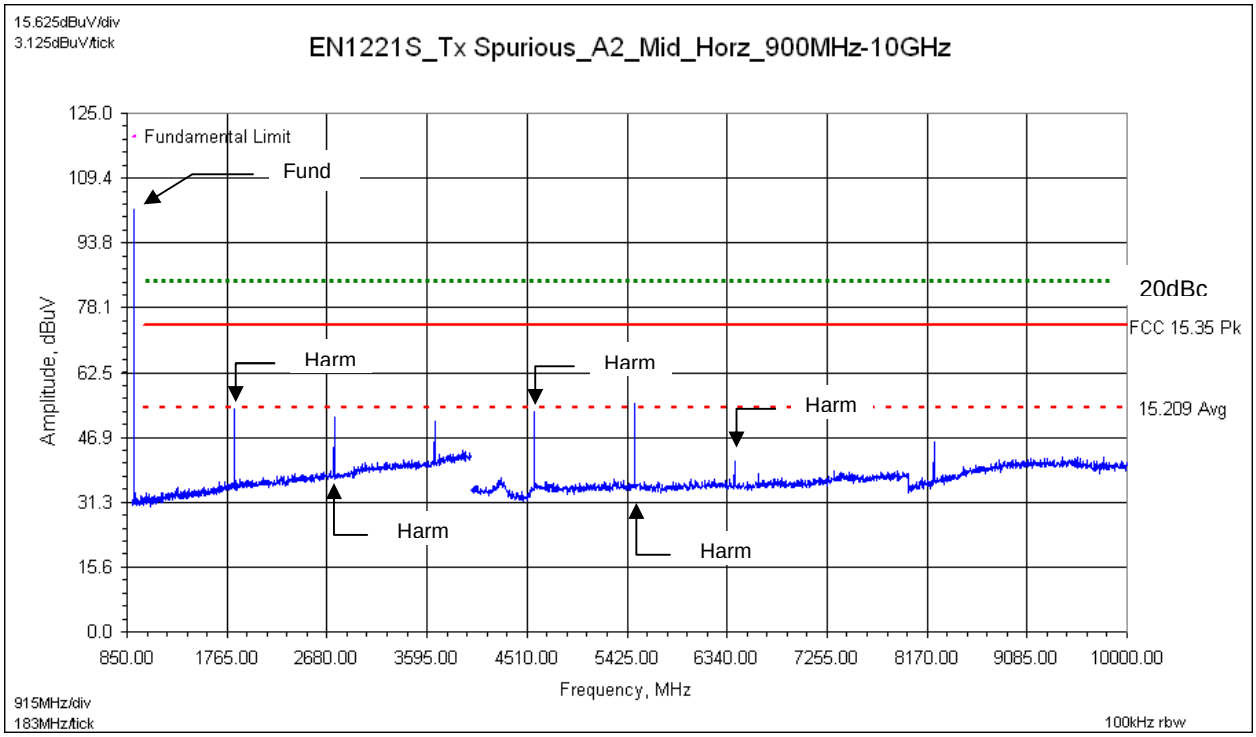
8.10 Pre-scan Plots: Mid Channel – Axis 2

1GHz to 10GHz

Vertical Antenna – Product Axis 2



Horizontal Antenna – Product Axis 2

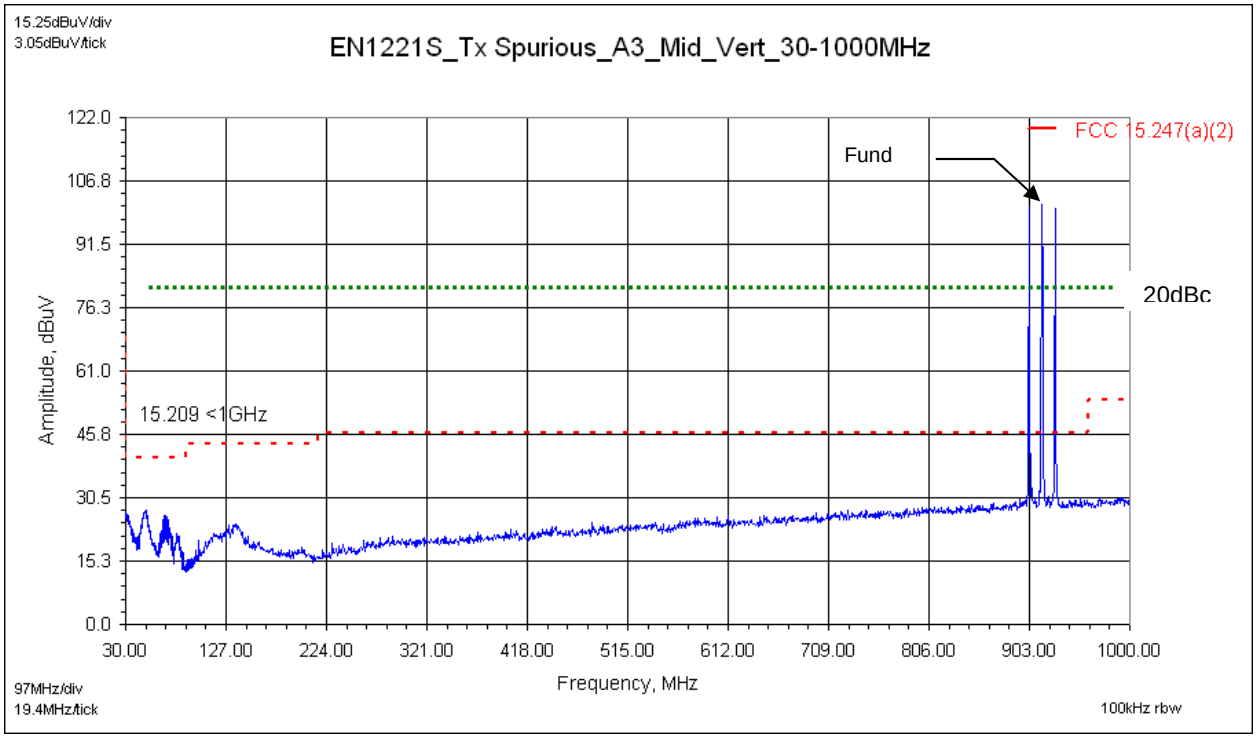


Peak detector, max-hold measurements

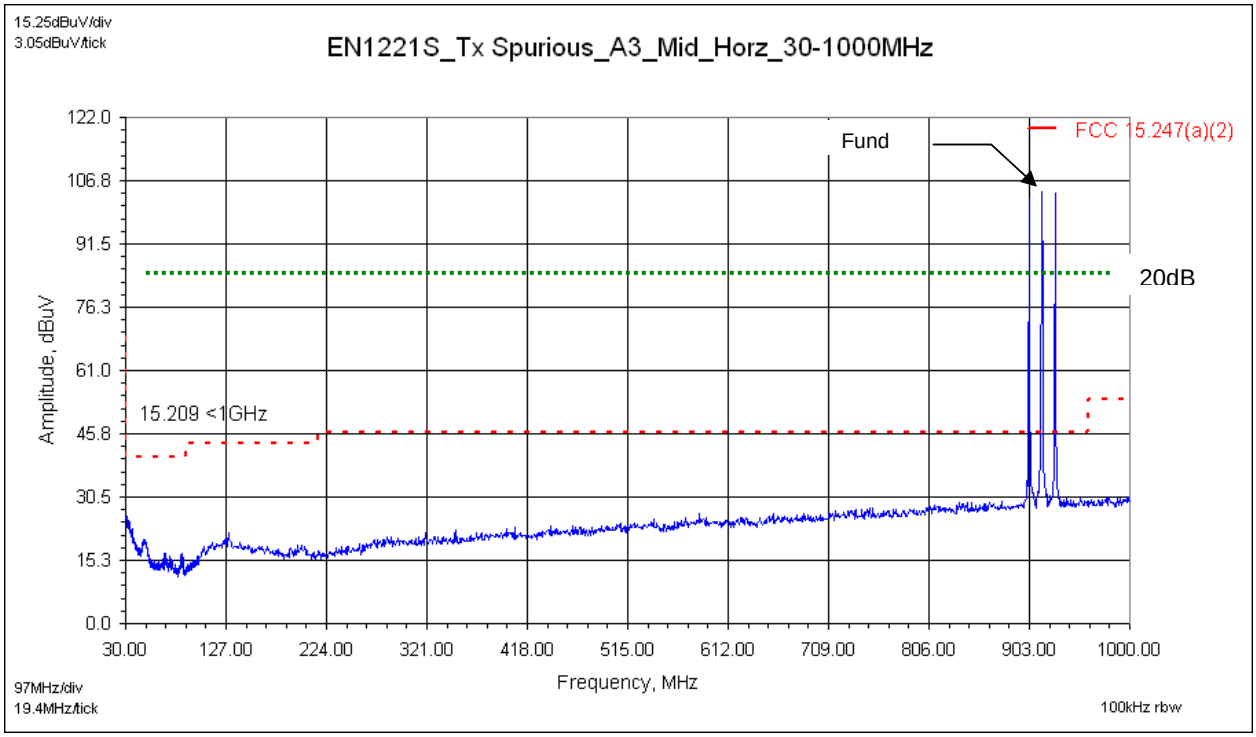
8.11 Pre-scan Plots: Low, Mid, High Channel – Axis 3

30MHz to 1000MHz

Vertical Antenna – Product Axis 3



Horizontal Antenna – Product Axis 3

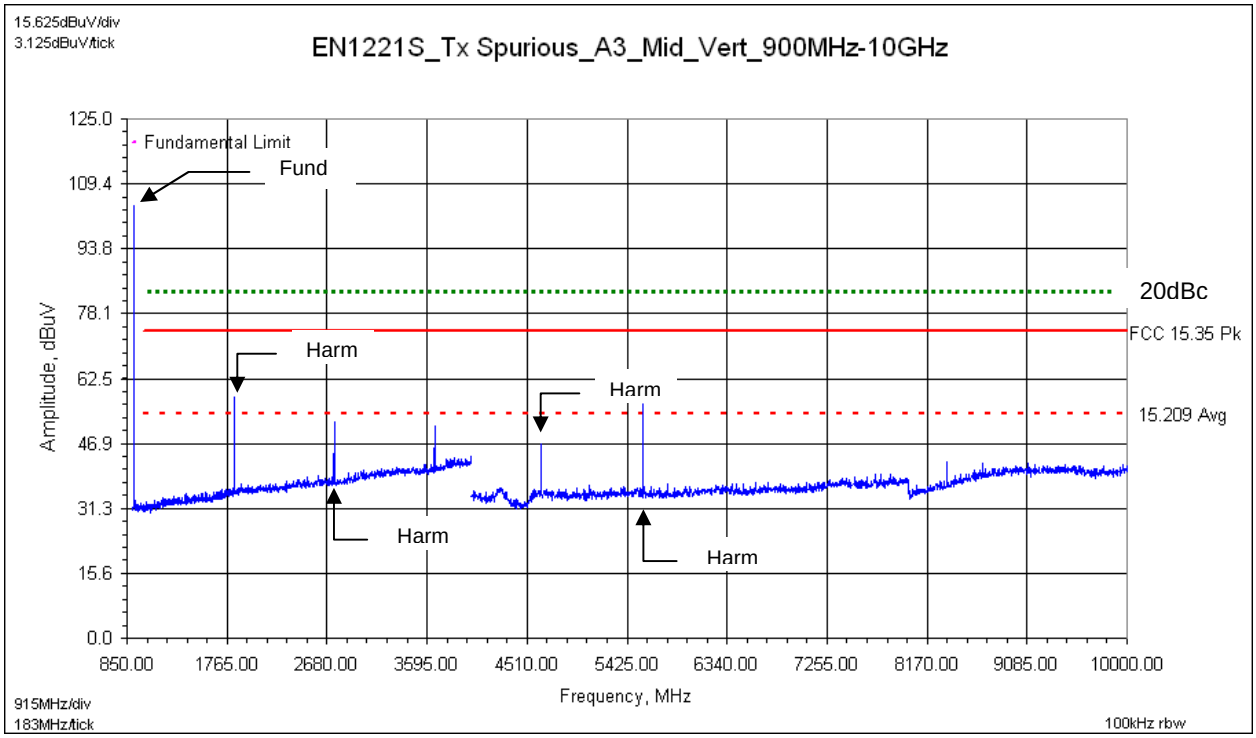


Peak detector, max-hold measurements

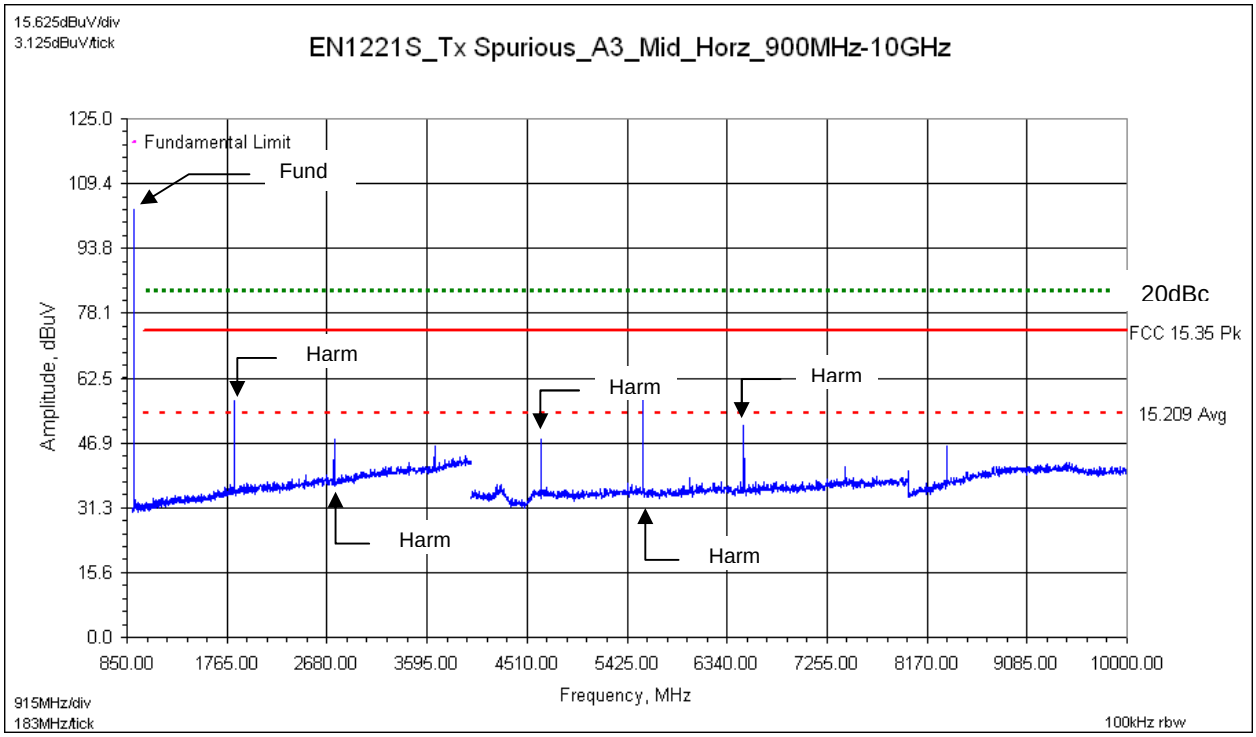
8.12 Pre-scan Plots: Mid Channel – Axis 3

1GHz to 10GHz

Vertical Antenna – Product Axis 3



Horizontal Antenna – Product Axis 3



Peak detector, max-hold measurements

Notes:

1) The product was tested/plotted in all 3-axes.
2) The worst-case channel for output power was the middle channel. The worst-case axis was Axis 1.

9 Unintentional Radiated Emissions - Idle/Standby Mode of Operation – FCC 15.109/ CISPR 22

9.1 Method

Unless otherwise stated no deviations were made from ANSI C63.4.

This testing was performed at Intertek Denver, located at 1795 Dogwood St., Suite 200, Louisville, CO 80027.

- FCC 15.109/ CISPR 22
- RSS-GEN, Clause 7.2.5

9.2 Specification:

The product must pass Unintentional Radiated Emissions – Class B.
Unwanted emissions below 1GHz must comply with the general field strength limits defined in FCC Part 15.109, when measured with a quasi-peak detector. Unwanted emissions above 1GHz are measured with an average detector. The Resolution Bandwidth is 120 kHz for frequencies 30 MHz -1000 MHz and 1 MHz for frequencies above 1000 MHz.

The EUT is placed on a plastic turntable that is 80 cm in height. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables are manipulated to produce worst-case emissions. The signal is maximized by rotating the turntable through a 360º rotation. The antenna height is varied from 1-4 meters. Both vertical and horizontal antenna configurations are utilized in the testing.

9.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	05/21/2014	05/21/2015
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/13/2013	11/13/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

9.4 Results:

The sample tested was found to Comply.

9.5 Results Summary

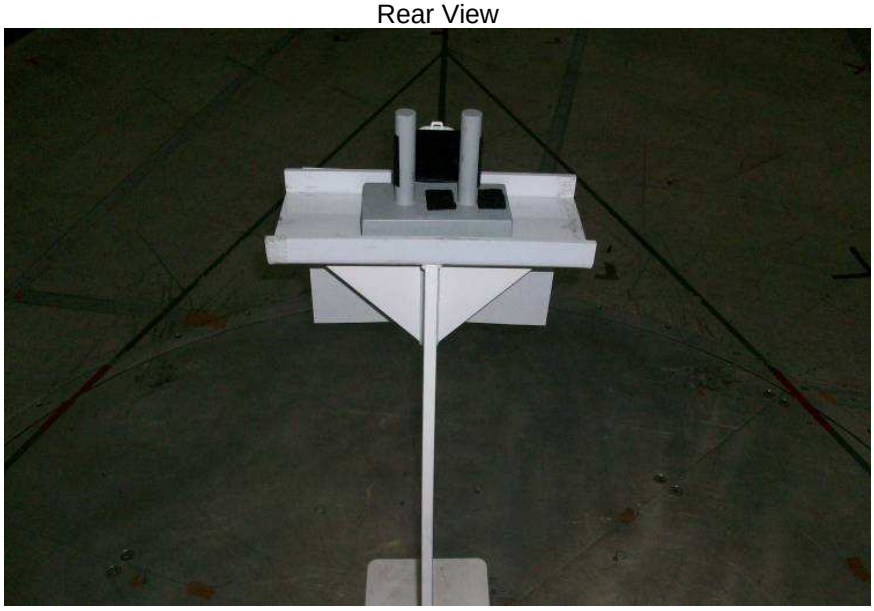
Frequency (MHz)	Final Radiated Field Strength Qp (dBuV/m)	Radiated Field Strength Limit Qp (dBuV/m)	Margin (dB)	Result
49.23	24.55	40	-15.45	Pass

Note: Product-to-Test Antenna Distance: 3-meters

9.6 Setup Photographs:

Front View

Rear View



9.7 Setup Photographs:

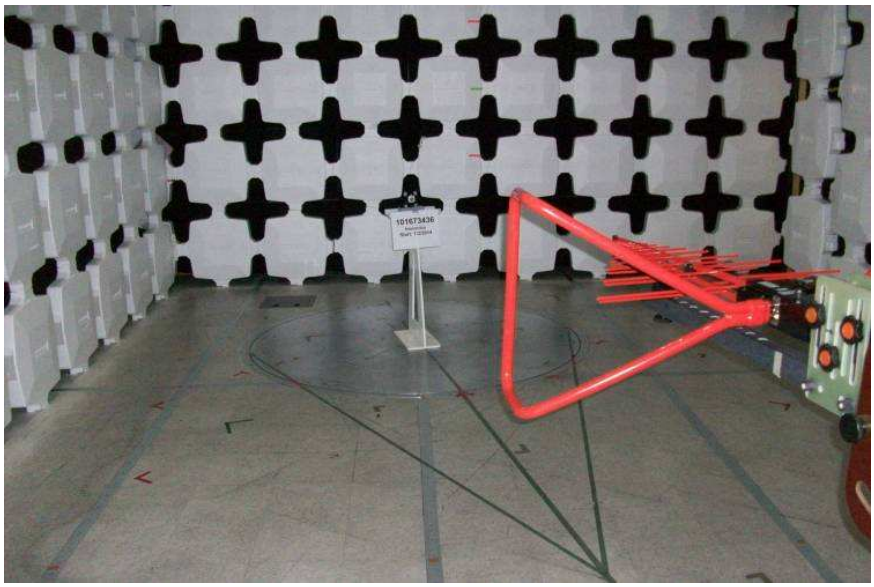
Product Test Axis 1 _ Horizontal

Product Test Axis 2 - Vertical

Product Test Axis 3 – Vertical & Rotated 90º

Photo:

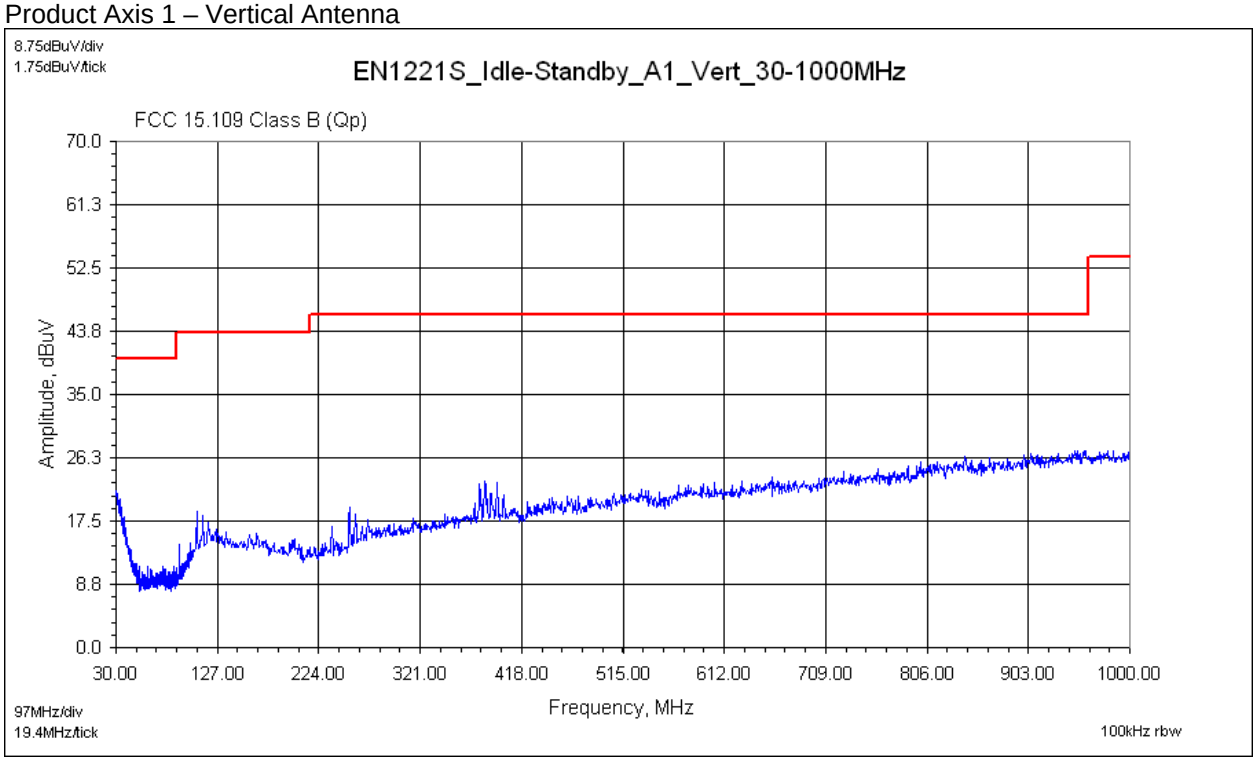
Antenna (30-1000 MHz)



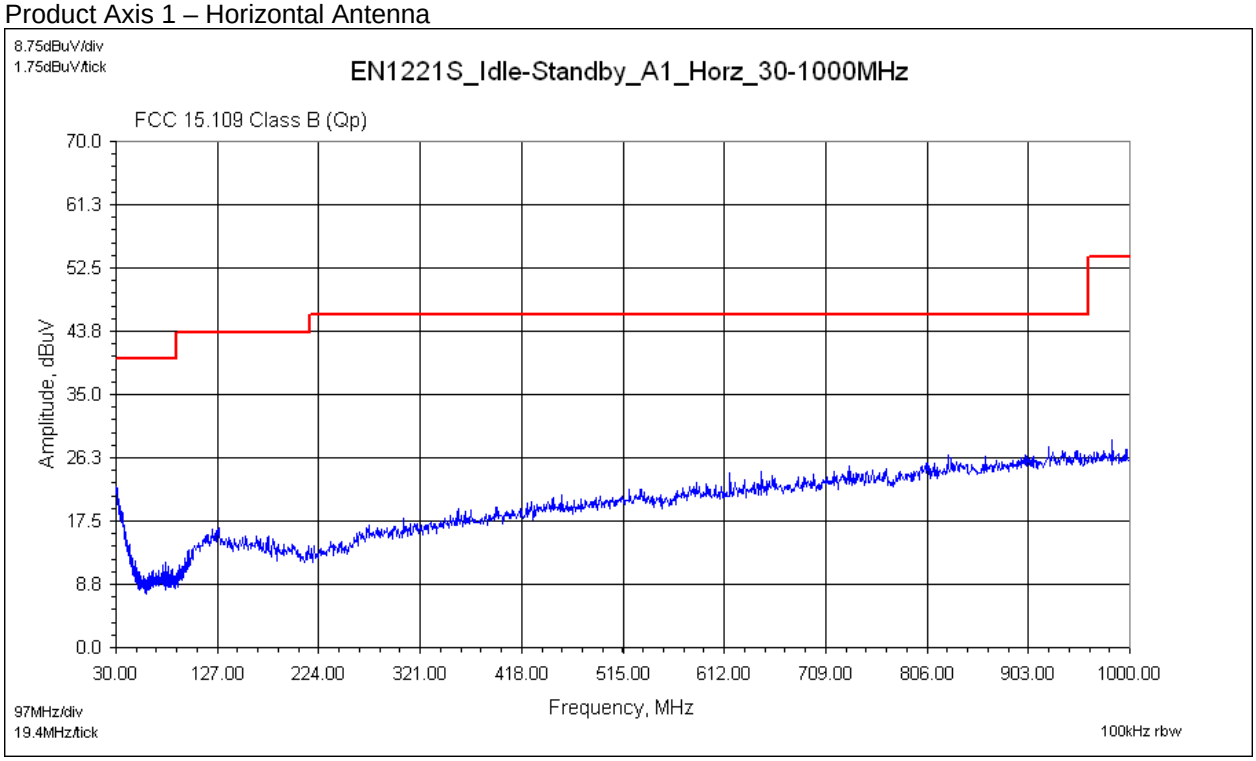
9.8 Pre-scan Plots:

Unintentional Radiated Emissions (30MHz to 1000MHz)

Product Axis 1 – Vertical Antenna



Product Axis 1 – Horizontal Antenna

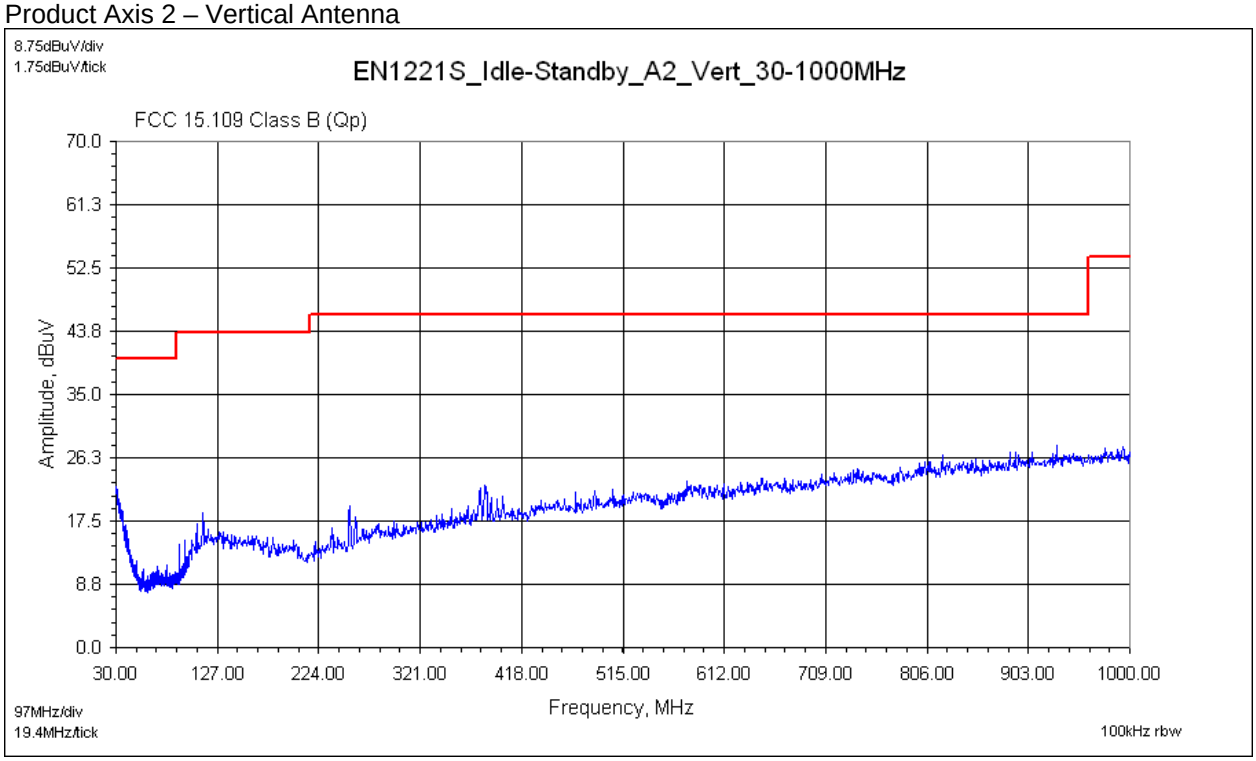


Peak detector, max-hold

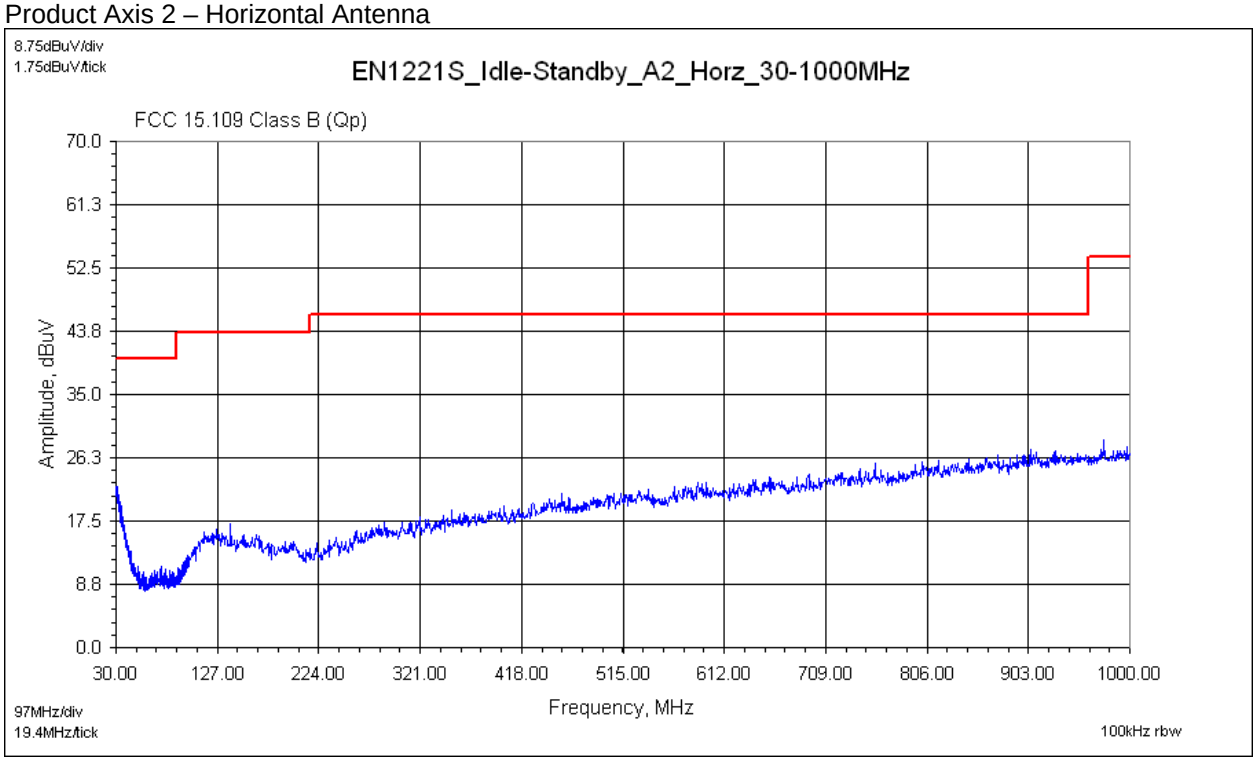
9.9 Pre-scan Plots:

Unintentional Radiated Emissions (30MHz to 1000MHz)

Product Axis 2 – Vertical Antenna



Product Axis 2 – Horizontal Antenna

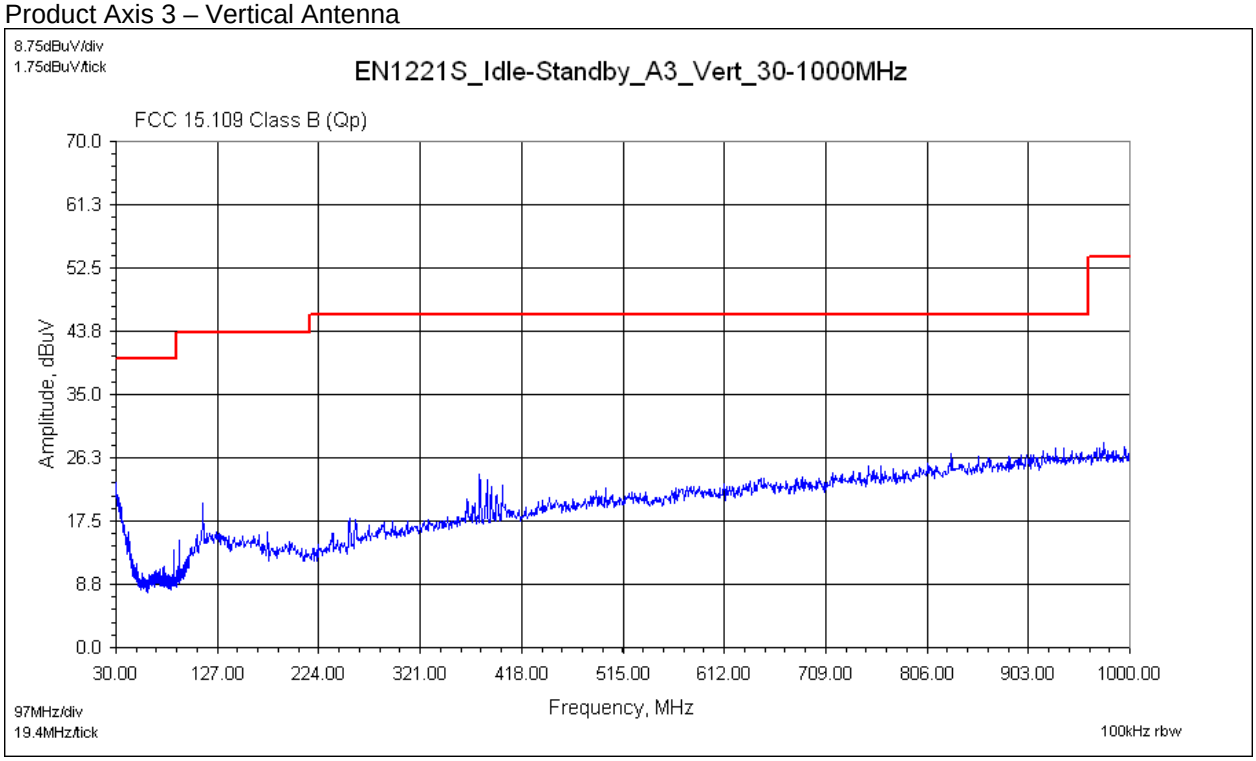


Peak detector, max-hold

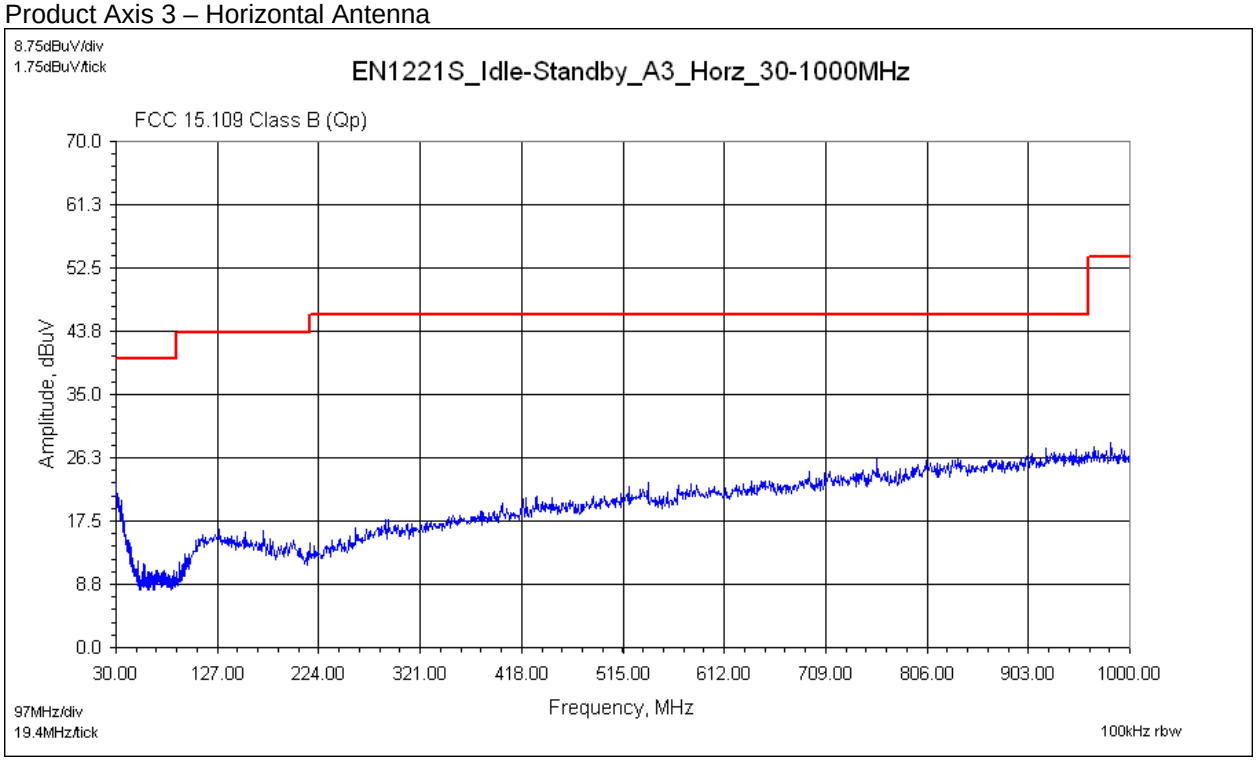
9.10 Pre-scan Plots:

Unintentional Radiated Emissions (30MHz to 1000MHz)

Product Axis 3 – Vertical Antenna



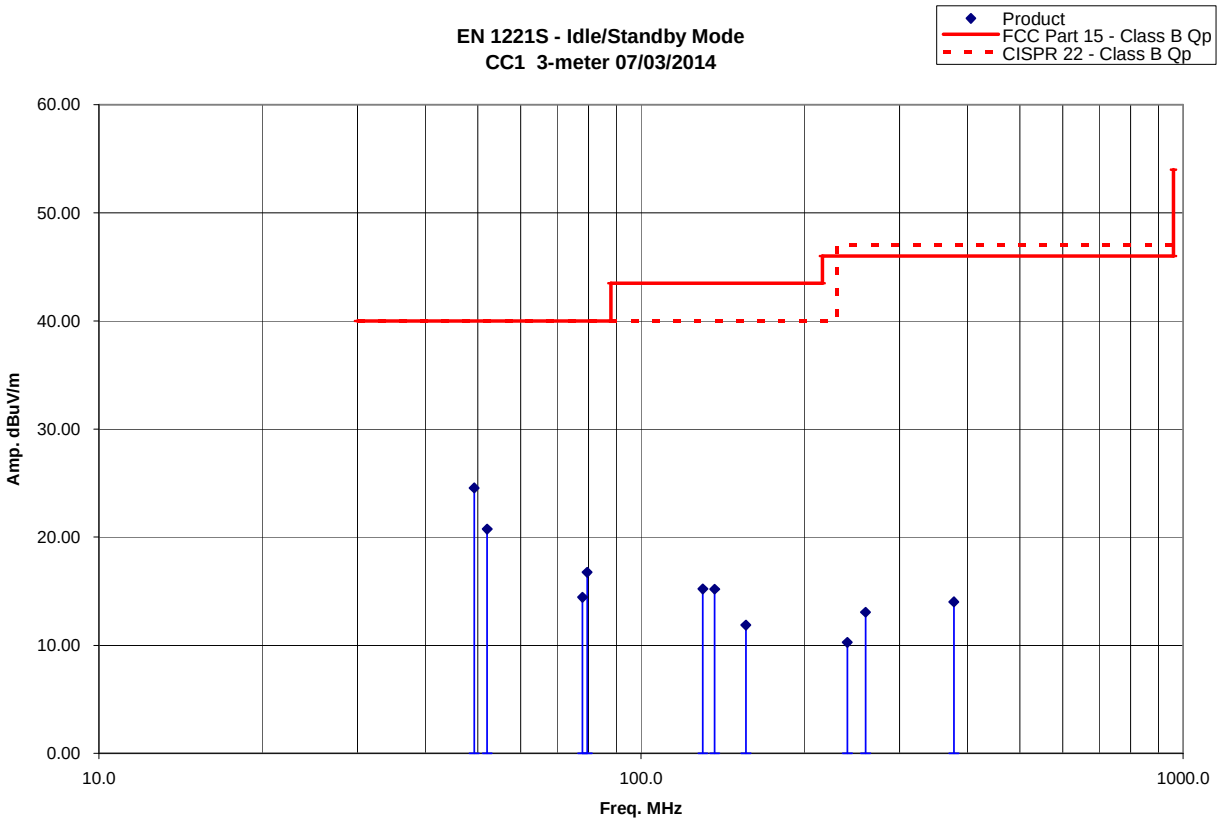
Product Axis 3 – Horizontal Antenna



Peak detector, max-hold

9.11 Final Measurement Plot

Unintentional Radiated Emissions (30MHz to 1000MHz)



9.12 Data:

Unintentional Radiated Electromagnetic Emissions

Test Report #:	**G101673436**	Test Area:	CC1 Radiated	Temperature:	23.8	°C
Test Method:	FCC 15.109 – Class B CISPR 22 – Class B	Test Date:	07/03/2014	Relative Humidity:	23.4	%
EUT Model #:	EN 1221S	EUT Power:	3VDC Internal Battery	Air Pressure:	83.5	kPa
EUT Serial #:	FCC1					
Manufacturer:	Inovonics Wireless					
EUT Description:	Pendant					
Notes:	Product configured in idle/standby mode of operation					

Level Key
Pk – Peak
Qp – Quasi Peak
Av - Average

Freq	Level	Det	Cable	Ant	Preamp	Atten	Final	Pol	Hgt	Az	Delta1	Delta2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	(V/H)	(m)	DEG	FCC 15.109 Class B	CISPR 22 Class B	(MHz)
Measurements: 30MHz to 1000MHz – Vertical Antenna													
49.2308	43.50	**Qp**	0.77	8.53	28.25	0.00	24.55	V	1.05	142.0	- 15.45	-15.45	0.120
52.0000	40.43	**Qp**	0.77	7.80	28.24	0.00	20.76	V	1.00	355.0	- 19.24	-19.24	0.120
78.0000	33.93	**Qp**	0.77	7.90	28.15	0.00	14.45	V	1.00	70.0	- 25.55	-25.55	0.120
79.5513	36.31	**Qp**	0.77	7.80	28.14	0.00	16.74	V	1.05	147.0	- 23.26	-23.26	0.120
130.0000	28.97	**Qp**	0.78	13.40	27.93	0.00	15.22	V	1.15	294.0	- 28.30	-24.78	0.120
136.6987	29.27	**Qp**	0.79	13.03	27.89	0.00	15.20	V	1.28	46.0	- 28.32	-24.80	0.120
156.0000	26.13	**Qp**	0.84	12.70	27.79	0.00	11.88	V	1.05	2.0	- 31.64	-28.12	0.120
Measurements: 30MHz to 1000MHz – Horizontal Antenna													
240.0641	25.05	**Qp**	1.04	11.60	27.41	0.00	10.28	H	2.18	275.5	- 35.72	-36.72	0.120
259.3750	27.11	**Qp**	1.09	12.21	27.34	0.00	13.07	H	1.86	45.8	- 32.93	-33.93	0.120
377.6442	25.11	**Qp**	1.33	15.30	27.73	0.00	14.02	H	1.46	221.4	- 31.98	-32.98	0.120

Example calculation:

Measured Level	+	Cable Loss	+	Antenna Factor	-	Pre-Amp	+	Atten	=	Final Corrected Reading	Specification Limit	-	Final Corrected Reading	=	Delta Specification
(dBµV)		(dB)		(dB)		(dB)		(dB)		(dBµV/m)	(dBµV/m)		(dBµV/m)		
20.0		**3.0**		**5.0**		**10.0**		**0.0**		**18.0**	**40.0**		**18.0**		**- 22.0**

Notes:

1. Quasi-peak detector measurements ≤ 1GHz: 120kHz RBW, 300kHz VBW.
2. Average detector measurements > 1 GHz: 1MHz RBW, 10Hz VBW..
3. All measurements are field strength measurements taken at 3-meter product-to-antenna.
4. The product was tested in 3-axes.

Deviations, Additions, or Exclusions: None

10 20 dB Bandwidth – FCC 15.247 (a)(1)(i)

10.1 Method

Unless otherwise stated no deviations were made from ANSI C63.10 and FCC public notice DA 00-705.

This testing was performed at Intertek Denver, located at 1795 Dogwood St., Suite 200, Louisville, CO 80027.

- FCC 15.247 (a)(1)(i)
- RSS-210 A8.1(c)

10.2 Specification:

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

10.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
W1	Whip Antenna	Solar Electronics	---	---	VBU	VBU
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

10.4 Results:

The sample tested was found to Comply.

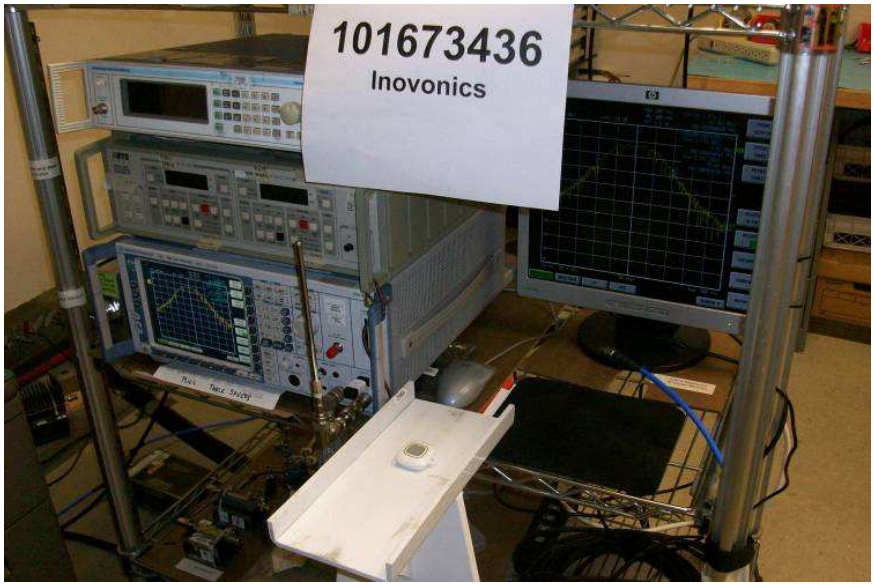
10.5 Measurement Summary:

The minimum 20dB Bandwidth (worst-case margin) was found to be 323.72 kHz: Highest Channel

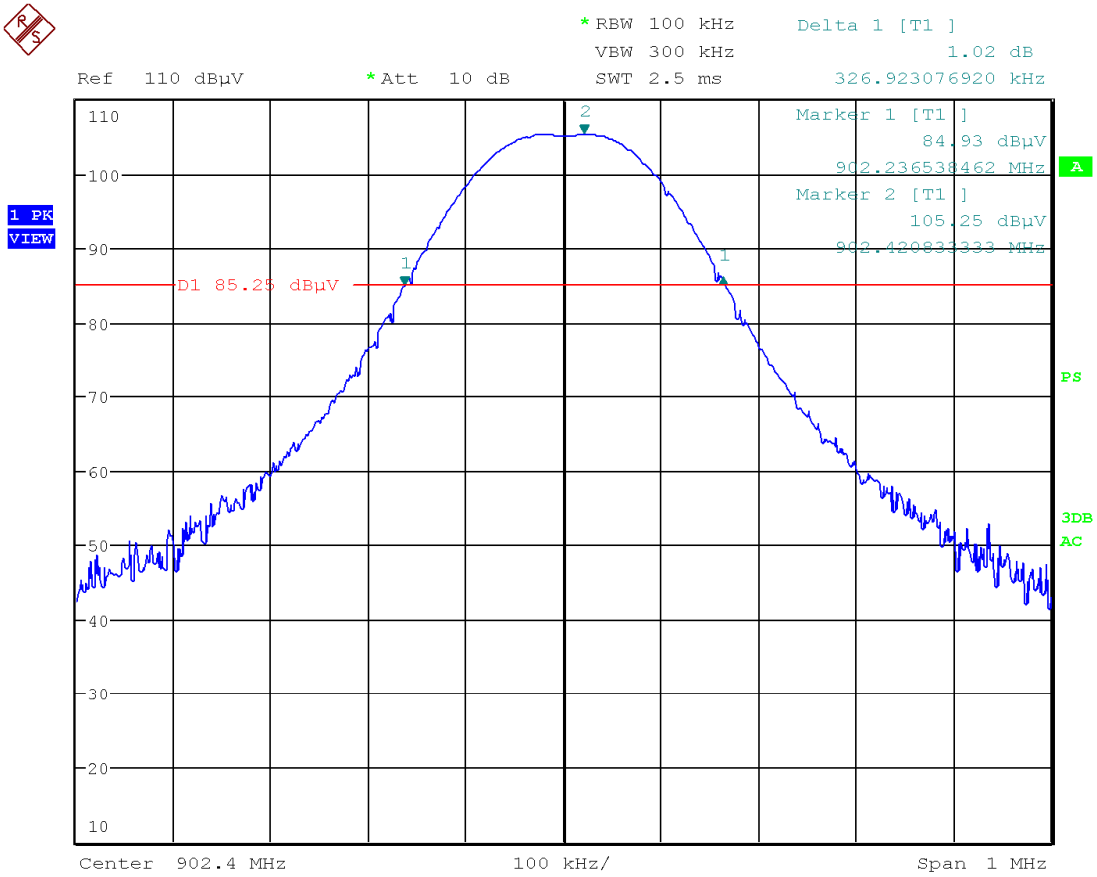
Tx Channel	Frequency (MHz)	Measured 20dB Bandwidth (kHz)	20dB Bandwidth Requirement (kHz)	Worst-Case Margin (kHz)	Result
Lowest	902.40	326.92	250kHz ≤ 500kHz	76.92	Pass
Middle	915.20	326.92	250kHz ≤ 500kHz	76.92	Pass
Highest	927.60	323.72	250kHz ≤ 500kHz	73.72	Pass

10.6 Setup Photographs:

Test Setup – 20dB Bandwidth



10.7 Plots: Low Channel

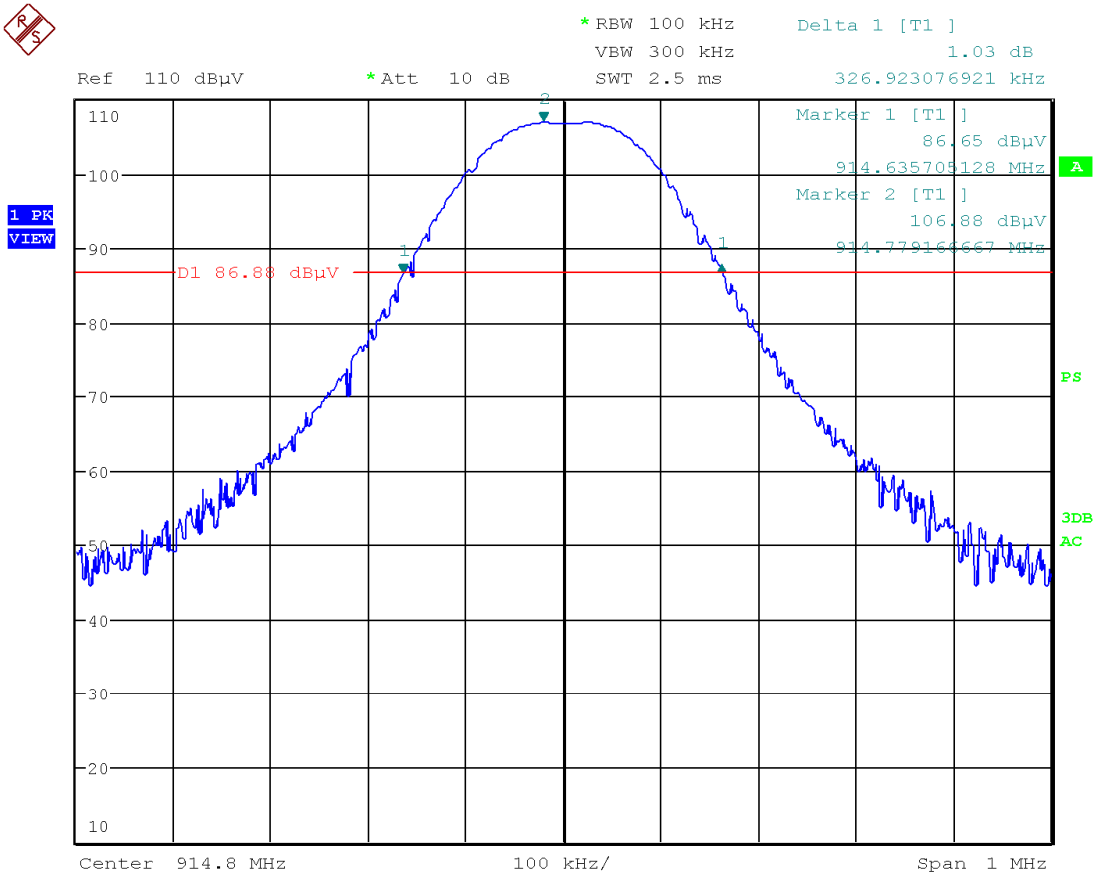


Date: 3.JUL.2014 15:36:28

Requirement: For products with ≥ 25 hopping channels, the minimum allowed 20dB Bandwidth is 250 kHz. The maximum allowed 20dB Bandwidth is 500 kHz.

Test Result: The 20dB Bandwidth was found to be 326.92 kHz: Lowest Channel

10.8 Plots: Mid Channel

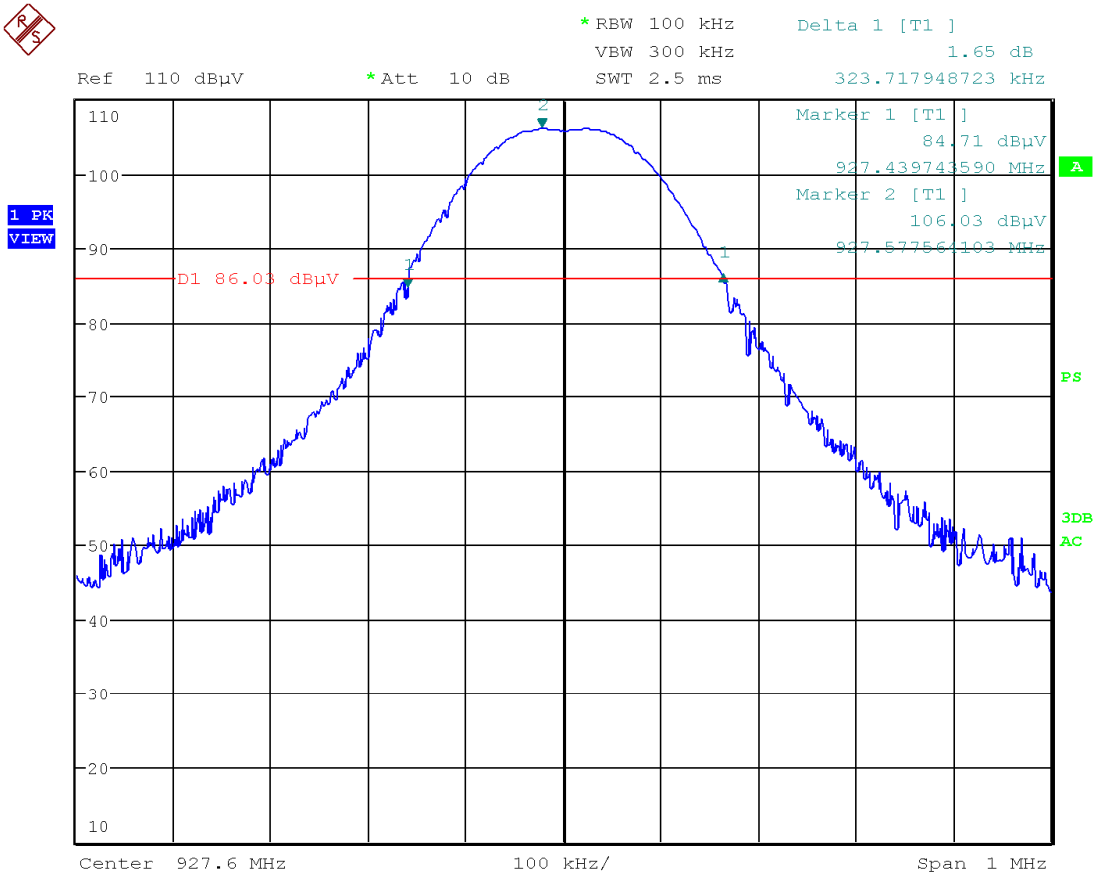


Date: 3.JUL.2014 15:39:02

Requirement: For products with ≥ 25 hopping channels, the minimum allowed 20dB Bandwidth is 250 kHz. The maximum allowed 20dB Bandwidth is 500 kHz.

Test Result: The 20dB Bandwidth was found to be 326.92 kHz: Mid Channel

10.9 Plots High Channel



Date: 3.JUL.2014 15:41:11

Requirement: For products with ≥ 25 hopping channels, the minimum allowed 20dB Bandwidth is 250 kHz. The maximum allowed 20dB Bandwidth is 500 kHz.

Notes: None

11 Carrier Frequency Separation – FCC 15.247 (a)(1)

11.1 Method

Unless otherwise stated no deviations were made from ANSI C63.10 and FCC public notice DA 00-705.

This testing was performed at Intertek Denver, located at 1795 Dogwood St., Suite 200, Louisville, CO 80027.

- FCC 15.247 (a)(1)
- RSS-210, A8.1(b)

11.2 Specification:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

11.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
W1	Whip Antenna	Solar Electronics	---	---	VBU	VBU
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

11.4 Results:

The sample tested was found to Comply.

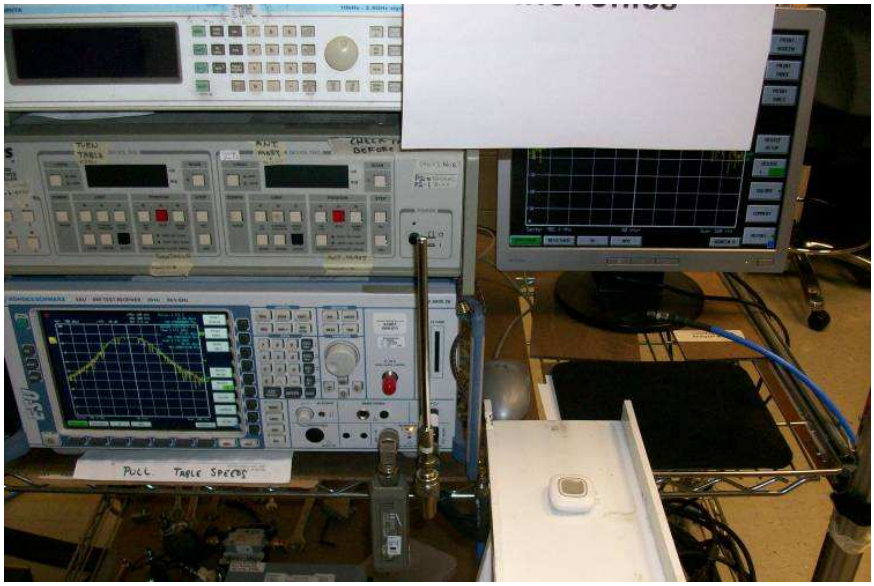
11.5 Results Summary:

The minimum (worst-case) hopping channel frequency separation was found to be 808.33 kHz, which is greater than the measured maximum 20dB Bandwidth of 326.92kHz.

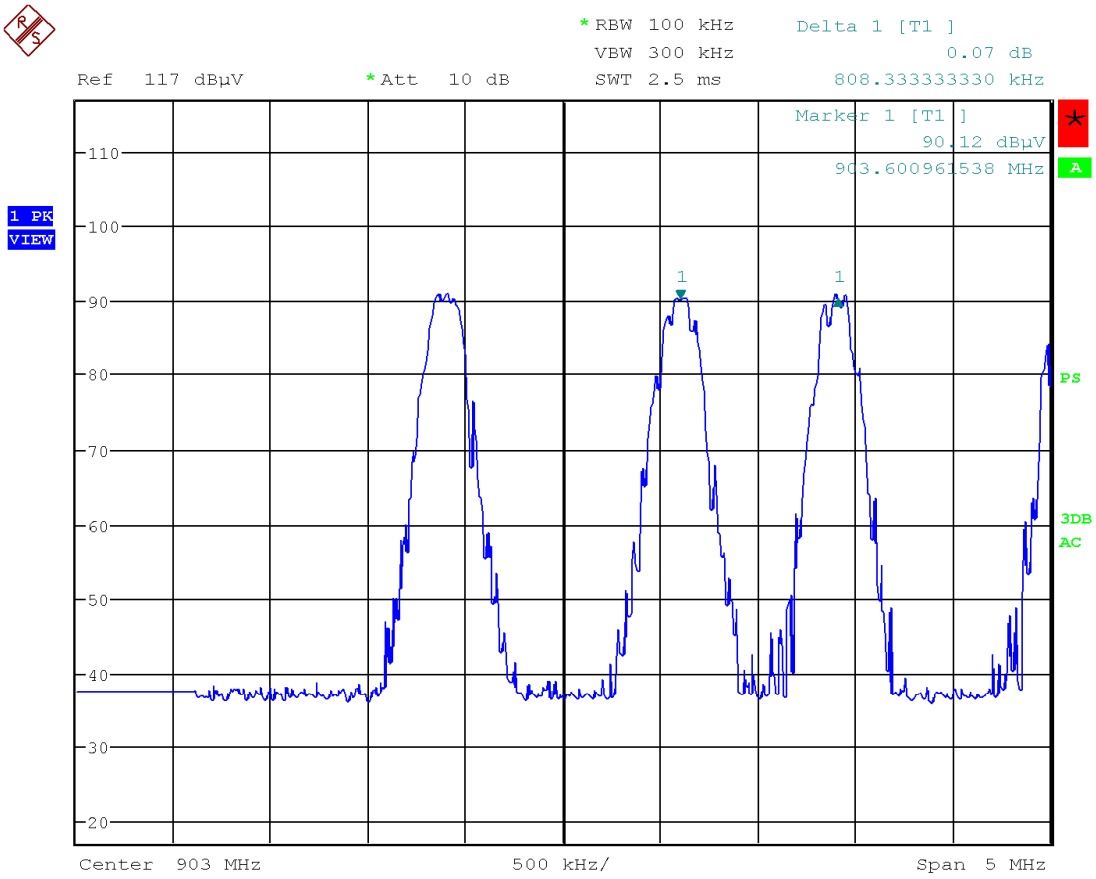
Tx Channel	Frequency (MHz)	Minimum Channel Carrier Frequency Separation (kHz)	Maximum 20dB BW (kHz)	Margin (kHz)	Result
2-Adjacent	~ 903.6	808.33	326.92	481.41	Pass

11.6 Setup Photographs:

Test Setup – Carrier Frequency Separation



11.7 Plots: Minimum Carrier Frequency Separation (Worst-Case)



Date: 3.JUL.2014 16:29:27

Requirement: The minimum hopping channel carrier frequency separation is the greater of the 20dB Bandwidth and 25 kHz.

Test Result: The 20dB Bandwidth was found to be 323.72 kHz. The minimum hopping channel frequency separation was found to be 808.33 kHz.

12 Number of Hopping Frequencies – FCC 15.247 (a)(1)(i)

12.1 Method

Unless otherwise stated no deviations were made from ANSI C63.10 and FCC public notice DA 00-705.

This testing was performed at Intertek Denver, located at 1795 Dogwood St., Suite 200, Louisville, CO 80027.

- FCC 15.247 (a)(1)(i)
- RSS-210, A8.1(c)

12.2 Specification:

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

12.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
W1	Whip Antenna	Solar Electronics	---	---	VBU	VBU
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

12.4 Results:

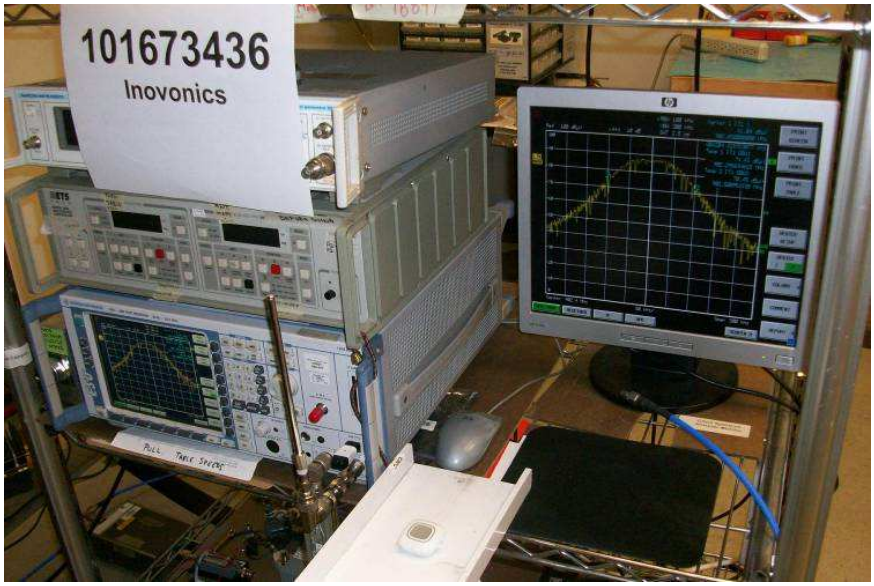
The sample tested was found to Comply.

12.5 Results Summary:

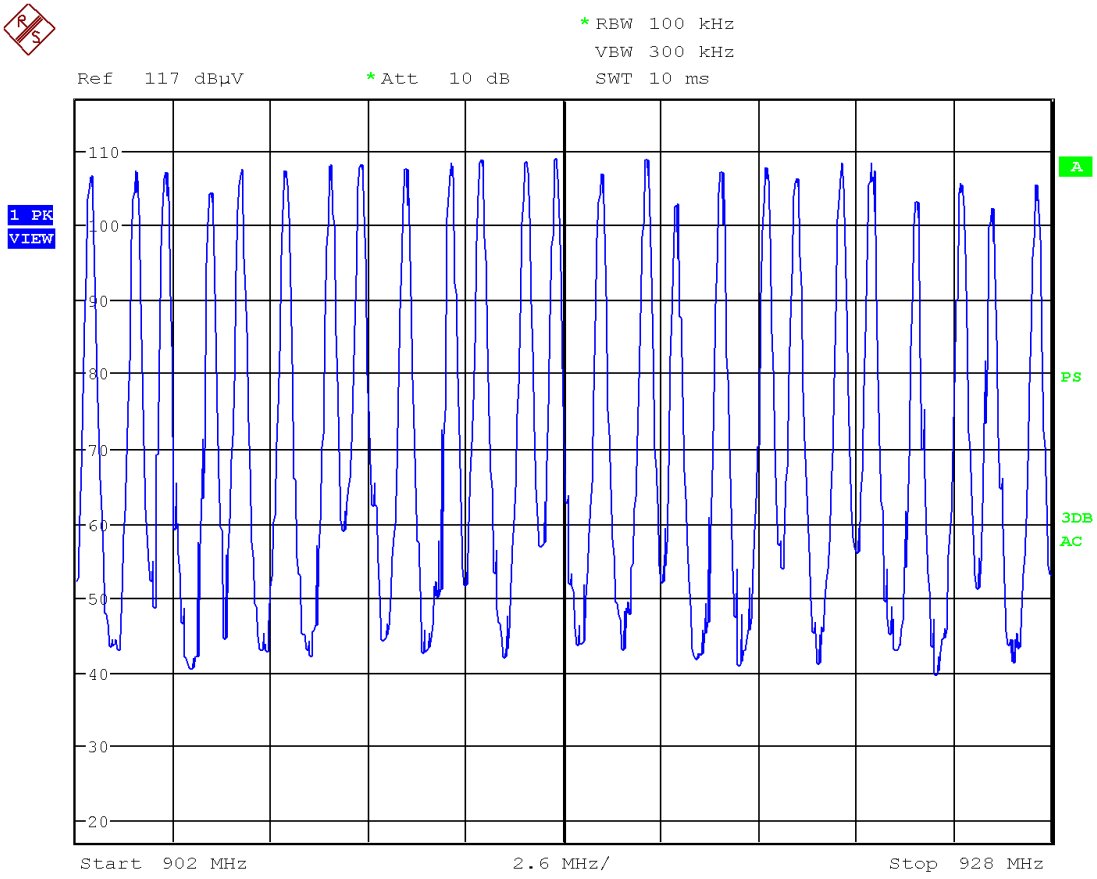
Test Result: This device was verified to use a minimum of 25 hopping frequencies.

12.6 Setup Photographs:

Test Setup – Tx Number of Hopping Frequencies



12.7 Plots: Number of Hopping Channels



Date: 3.JUL.2014 16:05:20

Requirement: Systems where the 20dB Bandwidth is greater than 250 kHz (measured 20dB BW = 323.72 kHz) require the usage of at least 25 hopping frequencies.

13 Time of Occupancy (Dwell Time) – FCC 15.247 (a)(1)(i)

13.1 Method

Unless otherwise stated no deviations were made from ANSI C63.10 and FCC public notice DA 00-705.

This testing was performed at Intertek Denver, located at 1795 Dogwood St., Suite 200, Louisville, CO 80027.

- FCC 15.247 (a)(1)(i)
- RSS-210, A8.1(c)

13.2 Specification:

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

13.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
W1	Whip Antenna	Solar Electronics	---	---	VBU	VBU
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

13.4 Results:

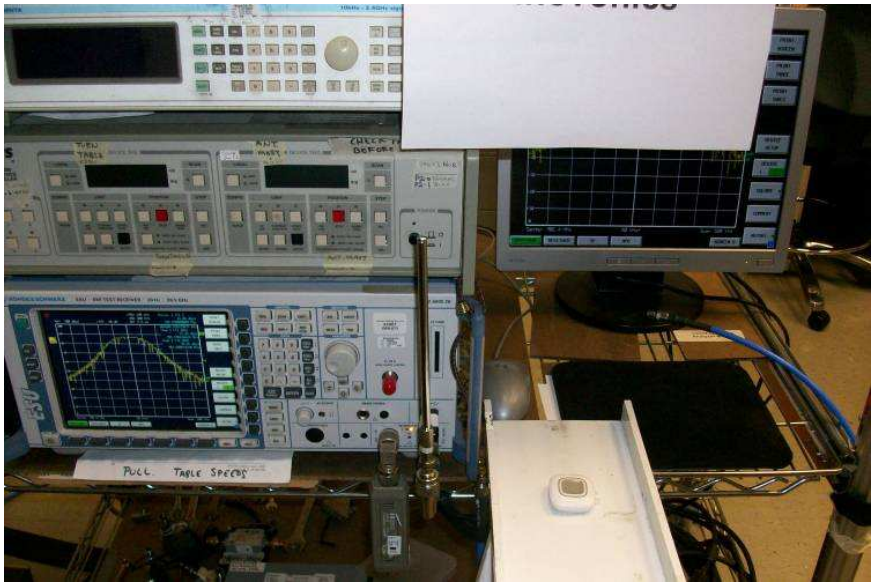
The sample tested was found to Comply.

13.5 Results Summary:

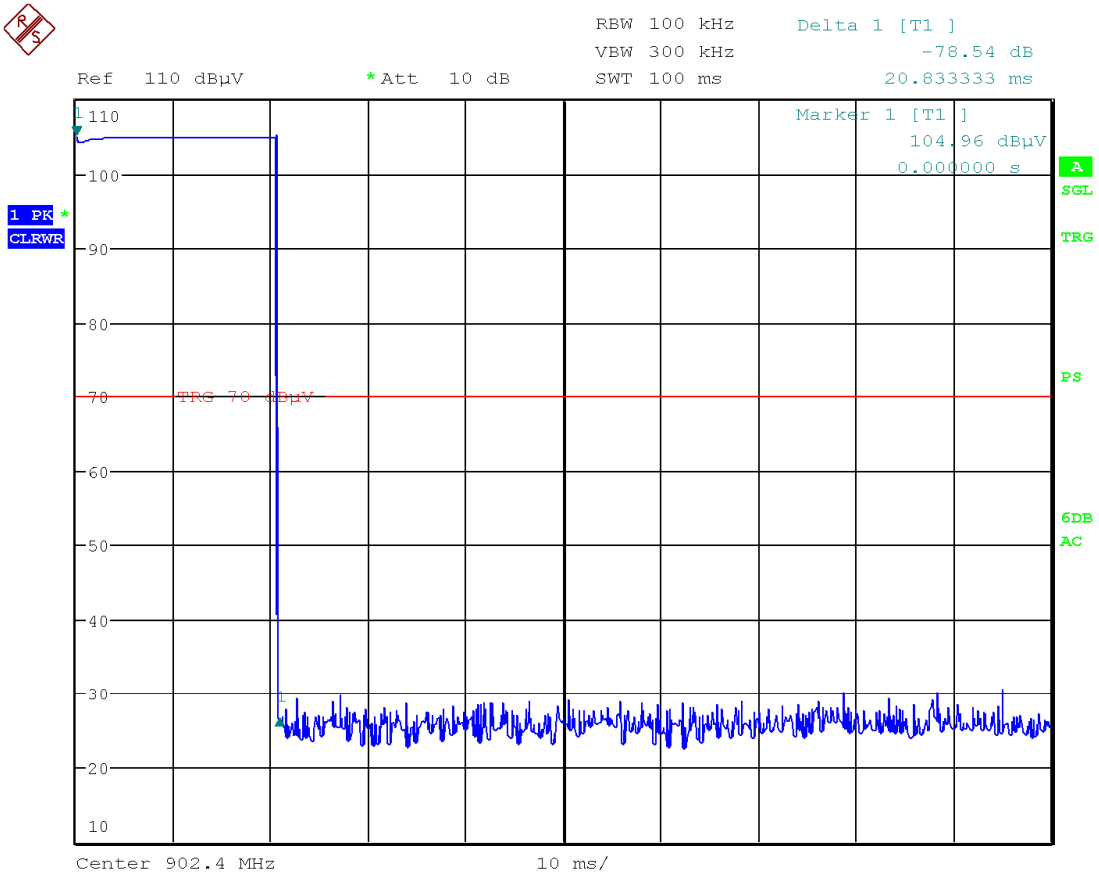
The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10-second period. This device was found to occupy the frequency for 0.0417 seconds per 10-sec period.

13.6 Setup Photographs:

Test Setup – Time of Occupancy (Dwell Time)

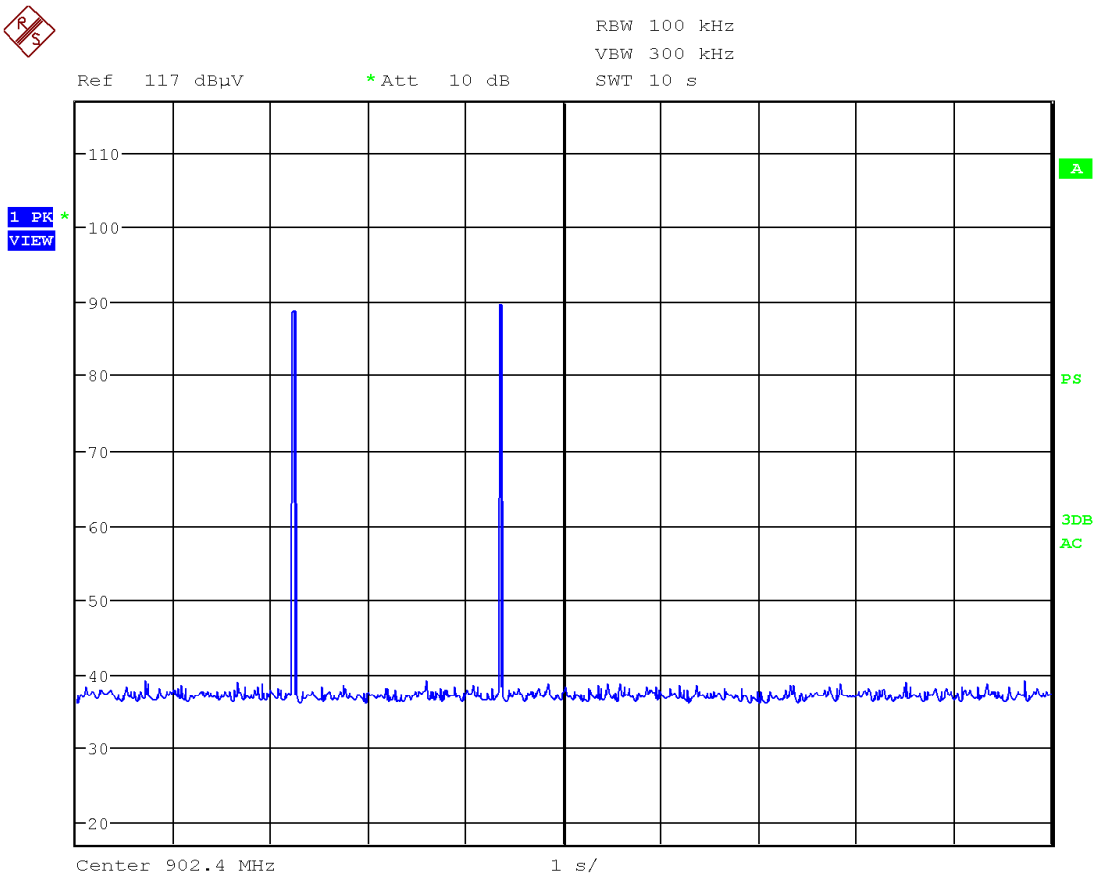


13.7 Plots: Low Channel



Date: 3.JUL.2014 14:48:13

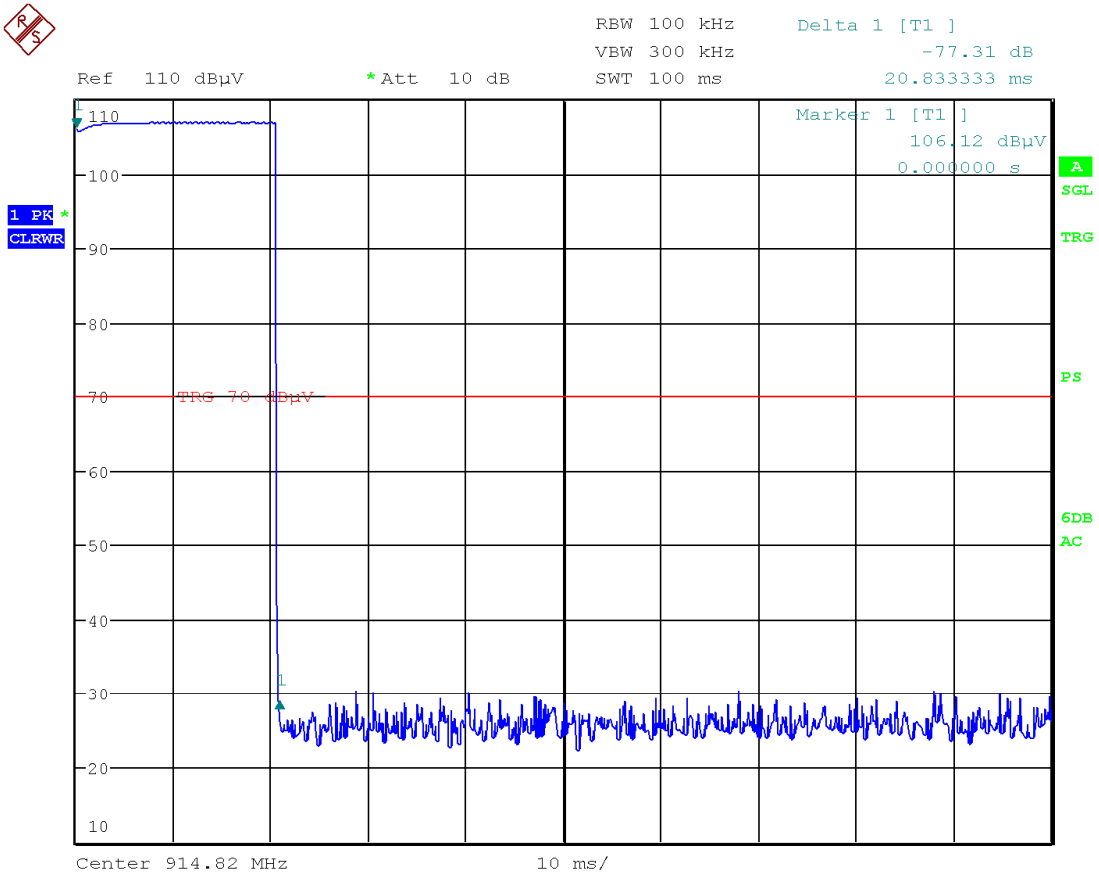
Duty Cycle Pulse-Width = 20.83 ms: Lowest Channel



Date: 3.JUL.2014 16:11:24

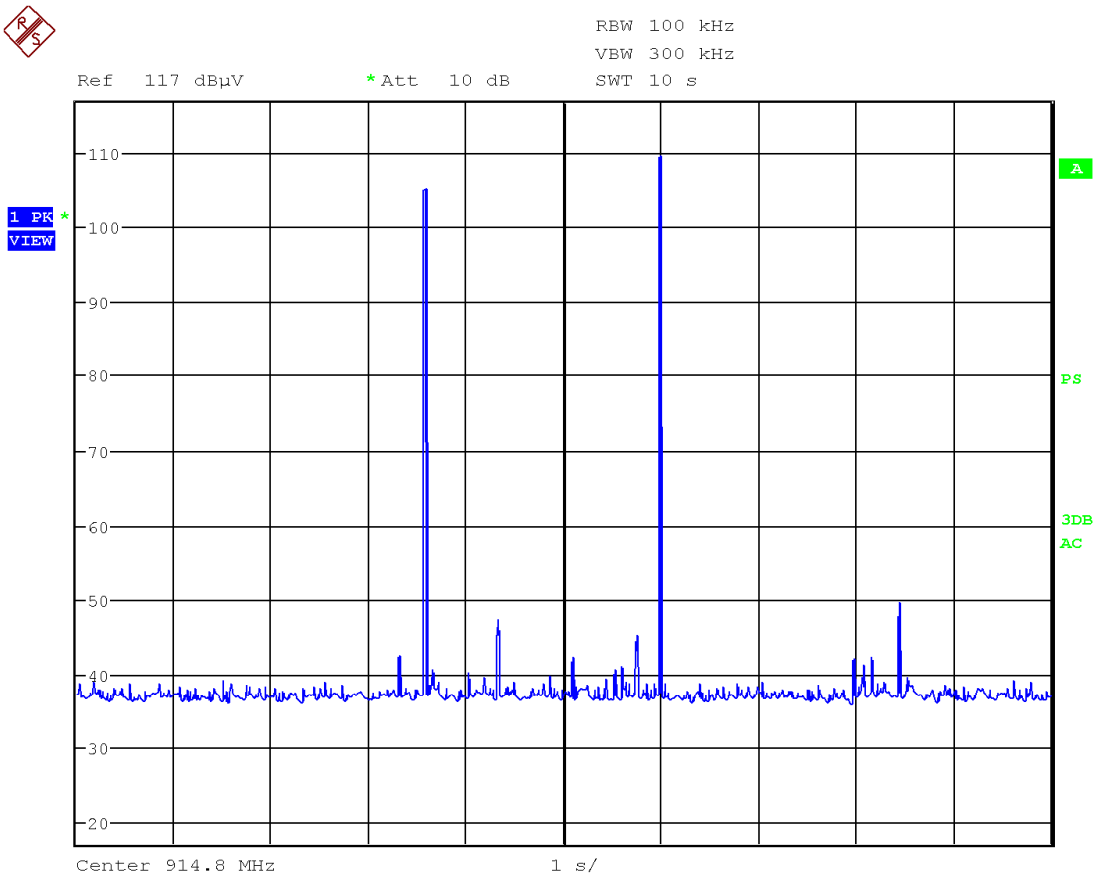
Requirement: The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. This device was found to occupy the frequency for 0.0417 seconds (0.02083 sec x 2).

13.8 Plots: Mid Channel



Date: 3.JUL.2014 15:03:38

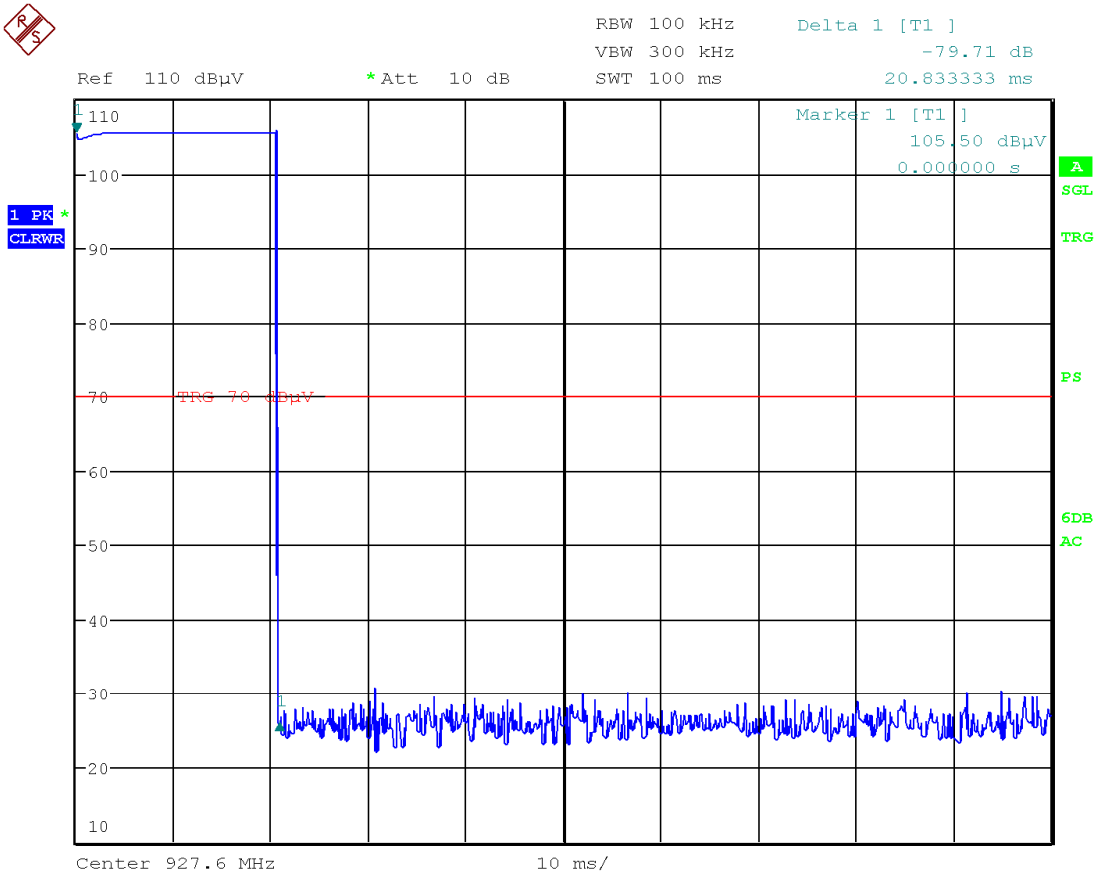
Duty Cycle Pulse-Width = 20.83 ms: Mid Channel



Date: 3.JUL.2014 16:13:08

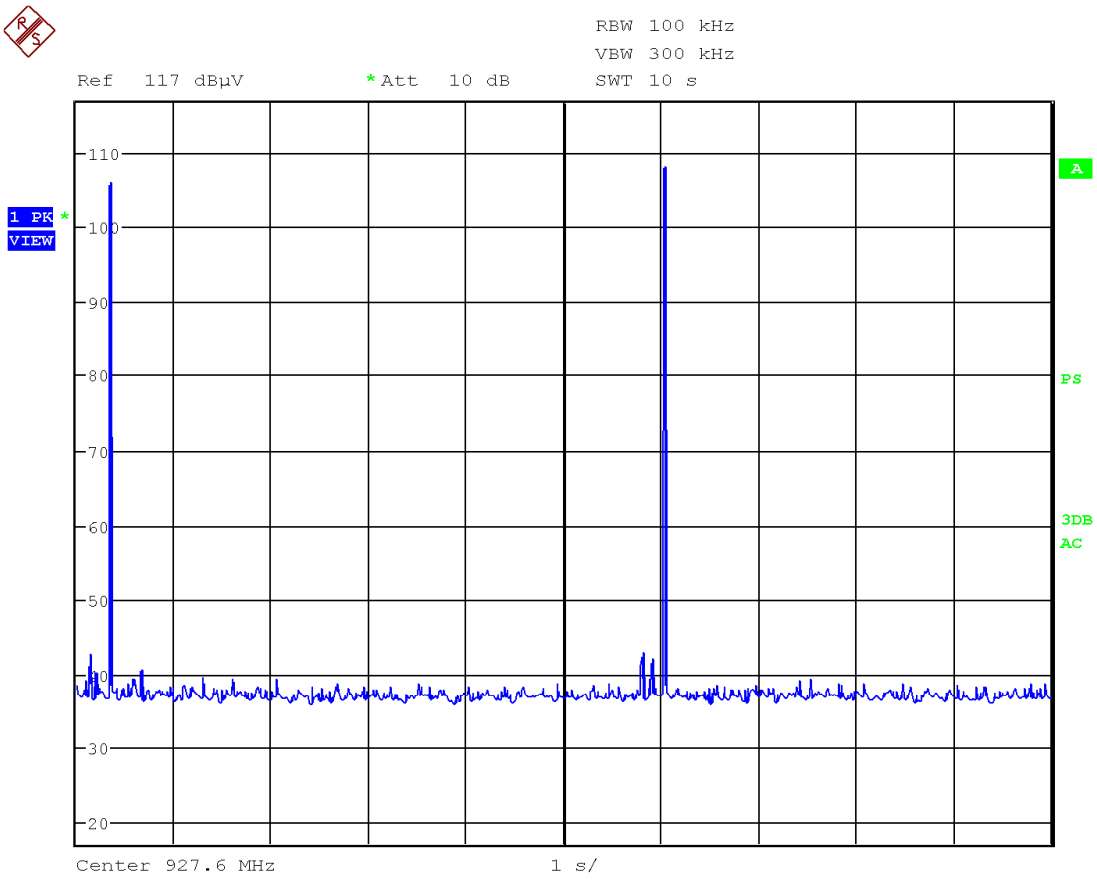
Requirement: The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. This device was found to occupy the frequency for 0.0417 seconds (0.02083 sec x 2).

13.9 Plots: High Channel



Date: 3.JUL.2014 15:11:08

Duty Cycle Pulse-Width = 20.83 ms: Highest Channel



Date: 3.JUL.2014 16:13:57

Requirement: The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. This device was found to occupy the frequency for 0.0417 seconds (0.02083 sec x 2).

14 Occupied Bandwidth (OBW) – RSS-GEN, 4.6.1

14.1 Method

Unless otherwise stated no deviations were made from ANSI C63.10 and FCC public notice DA 00-705.

This testing was performed at Intertek Denver, located at 1795 Dogwood St., Suite 200, Louisville, CO 80027.

- RSS-GEN, Clause 4.6.1

14.2 Specification:

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal Occupied Bandwidth to be reported is to be its 99% power emission bandwidth, as calculated or measured.

14.3 Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/29/2014	01/29/2015
W1	Whip Antenna	Solar Electronics	---	---	VBU	VBU
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 2.0	VBU	VBU

14.4 Results:

The sample tested was found to Comply.

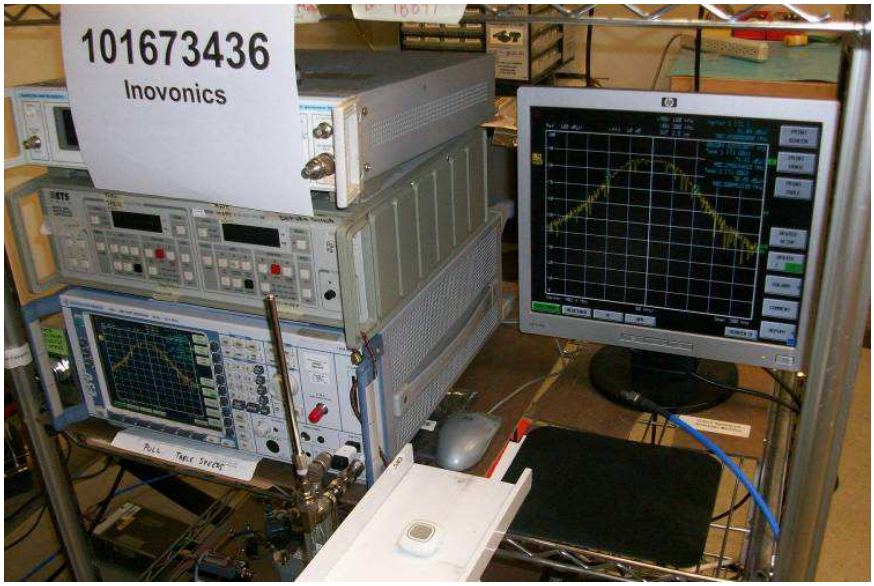
14.5 Measurement Summary:

The minimum OBW (99% power) was found to be 278.05 kHz: Highest Channel

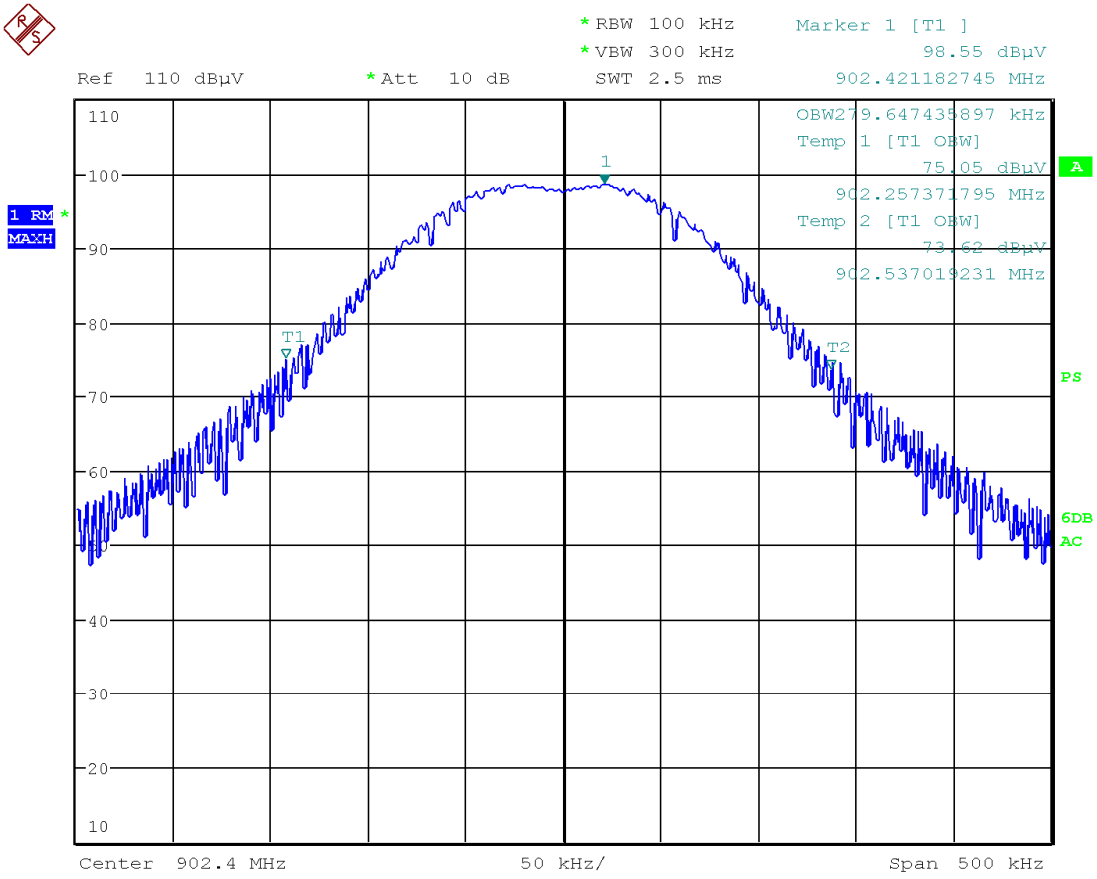
The maximum OBW (99% power) was found to be 280.45 kHz: Mid Channel

14.6 Setup Photographs:

Test Setup – OBW



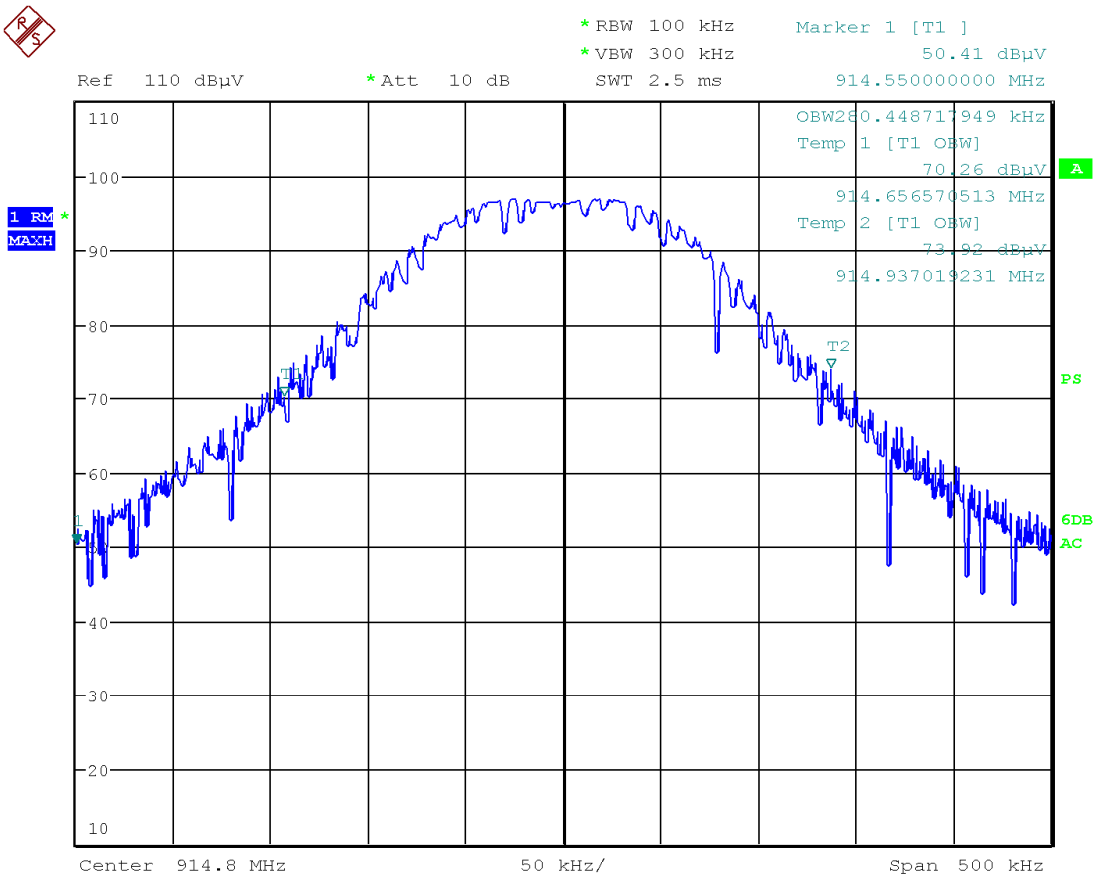
14.7 Plots: Low Channel



Date: 4.AUG.2014 10:10:03

Test Result: The OBW was found to be 279.65 kHz: Lowest Channel

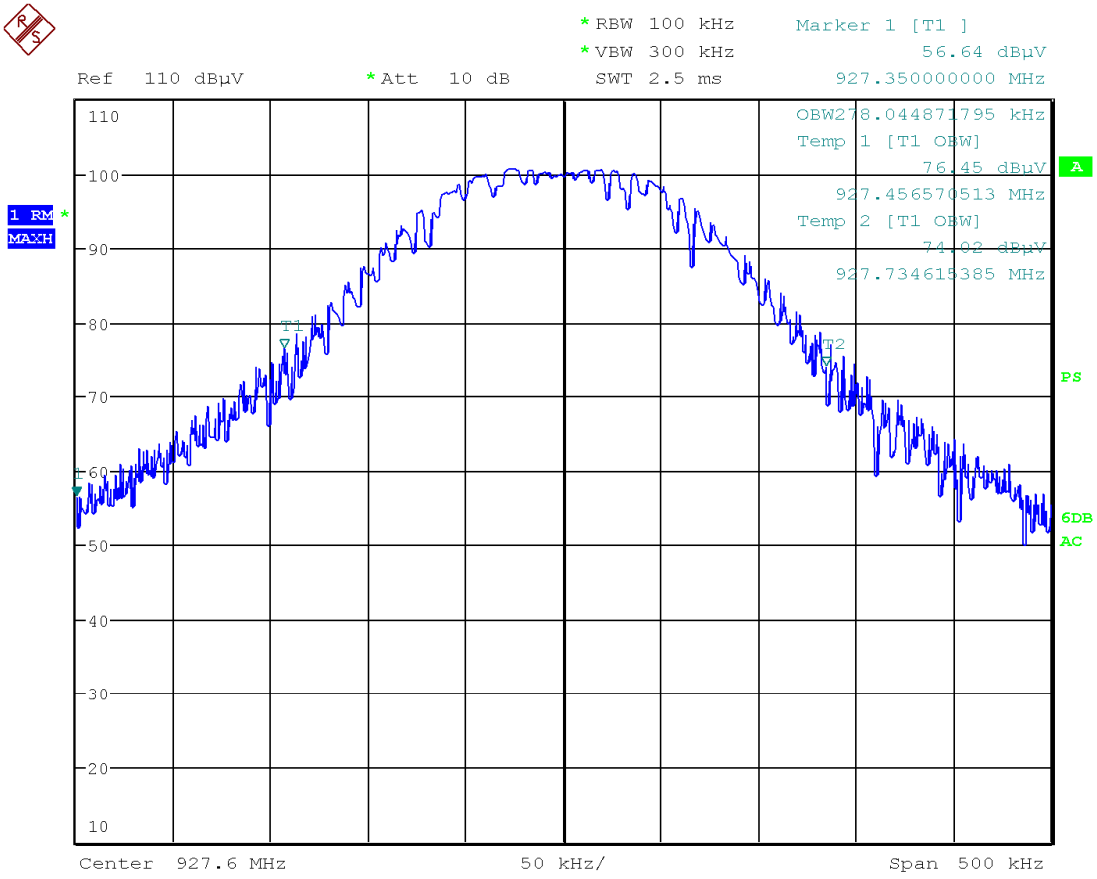
14.8 Plots: Mid Channel



Date: 4.AUG.2014 10:11:04

Test Result: The OBW was found to be 280.45 kHz: Mid Channel

14.9 Plots High Channel



Date: 4.AUG.2014 10:12:20

Test Result: The OBW was found to be 278.05 kHz: Highest Channel

Notes: Occupied Bandwidth is for reference only and used to determine the Emissions Designator.

15 Tx AC Power Conducted Emissions – Test not Applicable

- This test is not applicable – the product is internal battery-powered.

16 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty ±	Notes
Radiated emissions, 10kHz to 30 MHz	3.4 dB	
Radiated emissions, 30 to 200 MHz HP	2.2 dB	
Radiated emissions, 30 to 200 MHz VP	3.8 dB	
Radiated emissions, 200 to 1000 MHz HP	2.8 dB	
Radiated emissions, 200 to 1000 MHz VP	2.7 dB	
Radiated emissions, 1 to 18 GHz	5.2 dB	
Conducted port emissions 10kHz to 1000 MHz	1.0 dB	
Conducted port emissions 1 – 26.5 GHz	1.6 dB	
AC mains Conducted emissions, 9kHz to 30 MHz	3.14 dB	

17 Appendix A: Product Modifications - Not Required

- No product modifications were required to pass the testing in this report.

18 Revision History

Revision Level	Date	Report Number	Notes
0	8/14/2014	101673436DEN-001	Original