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Round Rock, TX 78665
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(512) 244-3371 Fax: (512) 244-1846

August 29, 2013

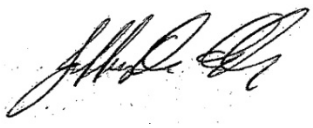
Tim Fiebrich
Naztec
522 Gillingham Dr
Sugar Land, TX 77478

Dear Tim:

Enclosed is the Wireless Test Report for the Naztec VDS-POD-S. This report can be used to demonstrate compliance with FCC and Industry Canada requirements for wireless devices in the United States and Canada.

If you have any questions, please contact me.

Sincerely,



Jeffrey A. Lenk
President

Enclosure

Project 13022-15

Naztec
VDS-POD-S

Wireless Certification Report

Prepared for:

Naztec
522 Gillingham Dr.
Sugar Land, TX 77478

By

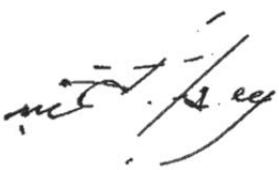
Professional Testing (EMI), Inc.
1601 N. A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

August 29, 2013

Reviewed by

Larry Finn
Product Development Engineer

Written by



Eric Lifsey
Test Engineer

Table of Contents

Revision History

Revision Number	Description	Date
00A	Initial Release	June 27, 2013
01A	Revised per ACB Comments	July 16, 2013
02A	Revised per ACB Comments	August 21, 2013
03A	Revised per ACB Comments	August 29, 2013

Applicant: Naztec
Applicant's Address: 522 Gillingham Dr.
Sugar Land, TX 77478

FCC ID: MD5-SM01
Model: VDS-POD-S
Project Number: 13022-15

The **VDS-POD-S** by **Naztec** was tested utilizing the following documents and found to be in compliance with the required criteria on the indicated test date.

47 CFR (USA)		
Section Reference	Parameter	Date
15.247(a)	Occupied Bandwidth, Hopping Frequency Separation, Number of Hopping Channels, Channel Occupancy Time	2/25/2013
15.247(b)	Peak Output Power (conducted)	3/6/2013
15.209 + 15.205	Harmonic & Spurious Emissions + Band Edge	3/6/2013
15.203	Antenna Requirements	6/18/2013
2.1091	Maximum Permissible Exposure	6/19/2013

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by **Naztec.** The undersigned is responsible for ensuring that this device will continue to comply with the FCC rules.

_____

Representative of **Naztec**

1.0 Introduction

1.1 Scope

This report describes the extent of the equipment under test (EUT) conformance to the intentional radiator requirements of the United States.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing. The procedure of ANSI C63.4: 2009 were utilized for making all emissions measurements.

1.2 EUT Description

The **VDS-POD-S** by **Naztec** is a sensor module installed a few cm below the roadway to detect and report traffic flow. It communicates wirelessly via network radio module(s) located on poles or structures above the traffic. It operates on battery power for up to 10 years and uses an integral antenna.

Table 1.3.1: Equipment Under Test

Manufacturer	Naztec, INC
Model Name	VDS-POD-S
Model Number	VDS-POD-S
FCC ID	MD5-SM01
Frequency (MHz)	902-928 MHz

1.3 EUT Operation

EUT was operated in a manner consistent with normal operation. The EUT is designed to be buried below the road surface. Measurements in this report were done entirely above ground.

1.4 Modifications

No modifications were made to the EUT during the performance of the test program.

1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. This site is registered with the FCC under Section 2.948 and Industry Canada per RS-212, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas, 78758, while the main office is located at 1601 N. A.W. Grimes Blvd., Suite B, Round Rock, Texas, 78665.

2.0 Applicable Documents and Clauses

Table 2.0.1: Applicable Documents

Document	Title	Release
ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment	2009
47 CFR	Part 15 – Radio Frequency Devices Subpart C -Intentional Radiators	

Table 2.0.2: Applicable Clauses

Clause Subject	Section References	Required?	Result
Radiated Output Power	15.249,	Yes	Pass
Occupied Bandwidth, 20 dB	2.1049	Yes	Pass
Field Strength of Radiated Spurious/Harmonic Emissions (30 MHz to 25 GHz)	15.205, 15.209	Yes	Pass
Antenna Construction	15.203	Yes	Pass
Maximum Permissible Exposure*	2.1091, FCC 447498 D01 General RF Exposure Guidance v05, RSS-102	Yes	Pass

*Reported separately.

3.0 Transmitter Duty Cycle

Measurements of transmitter on time and intervals between transmissions were made to determine the duty cycle factor.

3.2 Test Procedure

The EUT was loaded with firmware that simulated the maximum possible real world transmission rate and payload. Transmissions are triggered by vehicles passing over the sensor. The test command for hopping transmission was modified to produce this effect.

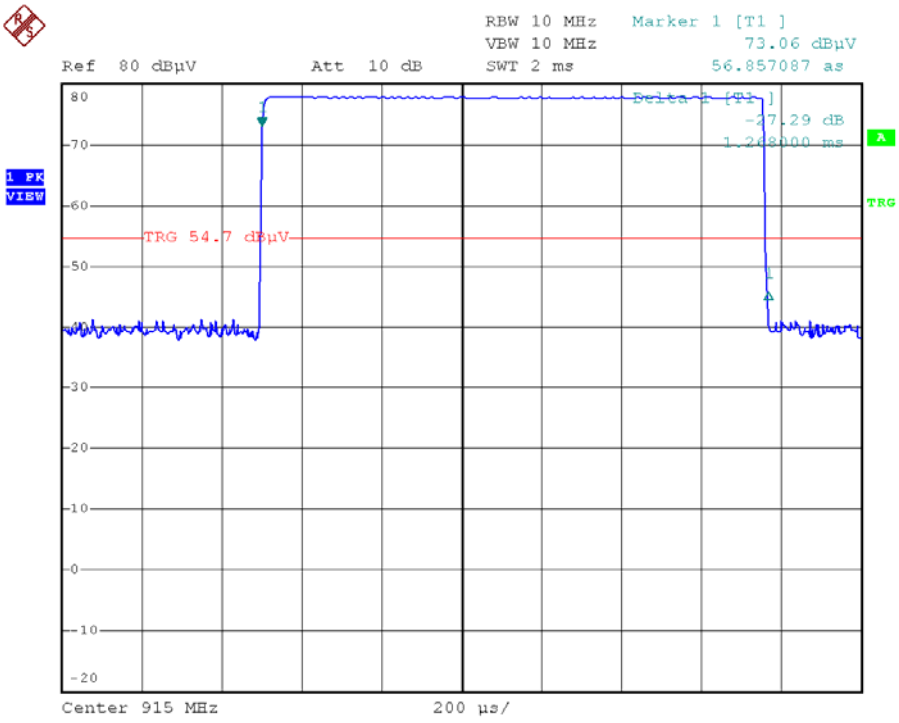
3.3 Test Criteria

Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. This is not a pass/fail measurement.

3.4 Test Results

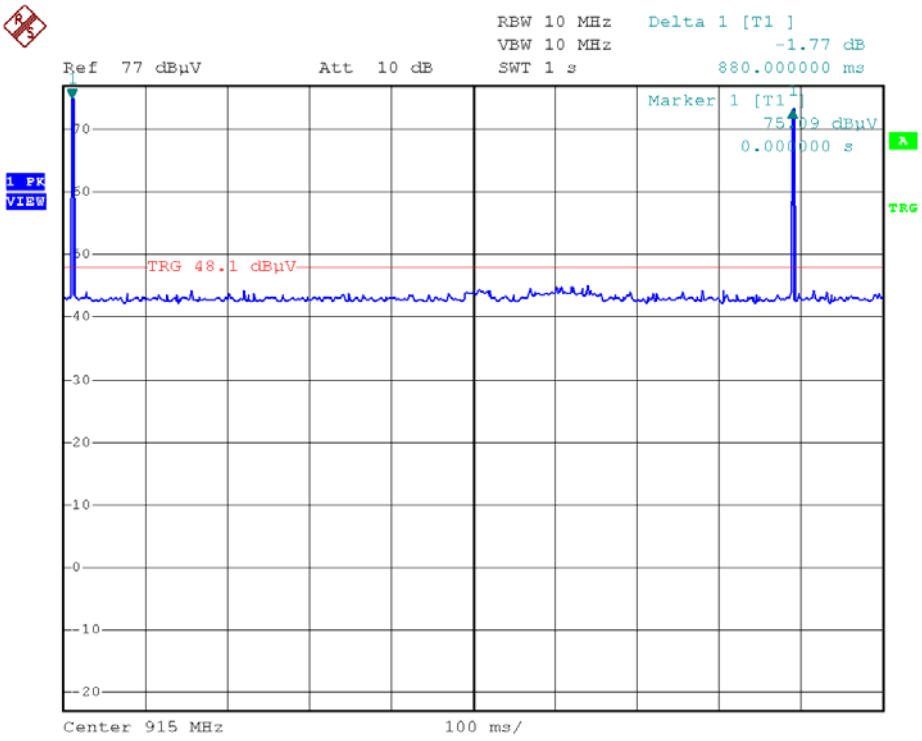
Measurements were performed on March 4, 2013 with the following results.

Plot 3.3.1 Transmit On Time



Measured maximum transmit time: 1.268 msec

Plot 3.3.2 Transmit Interval Time



Measured minimum transmit interval time: 880 msec (Allowed 100 msec.)

Table 3.3.1 Duty Cycle Factor Result

Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
1.268	880 msec (100 msec allowed)	= 20 * Log_{10} (1.268 msec / 100 msec)	-37.9	-20

4.0 Occupied Bandwidth

Occupied bandwidth measurement was made on the EUT.

4.1 Test Procedure

The EUT is configured for best signal/power and the bandwidth then is measured. A recording of the results is included.

4.2 Test Criteria

Section Reference	Parameter	Required?
2.1049	Bandwidth, 20 dB	Yes

4.3 Test Results

EUT was found to be in compliance with applicable requirements.

Channel	Measured BW (kHz)
L	177.0
M	176.0
H	180.0

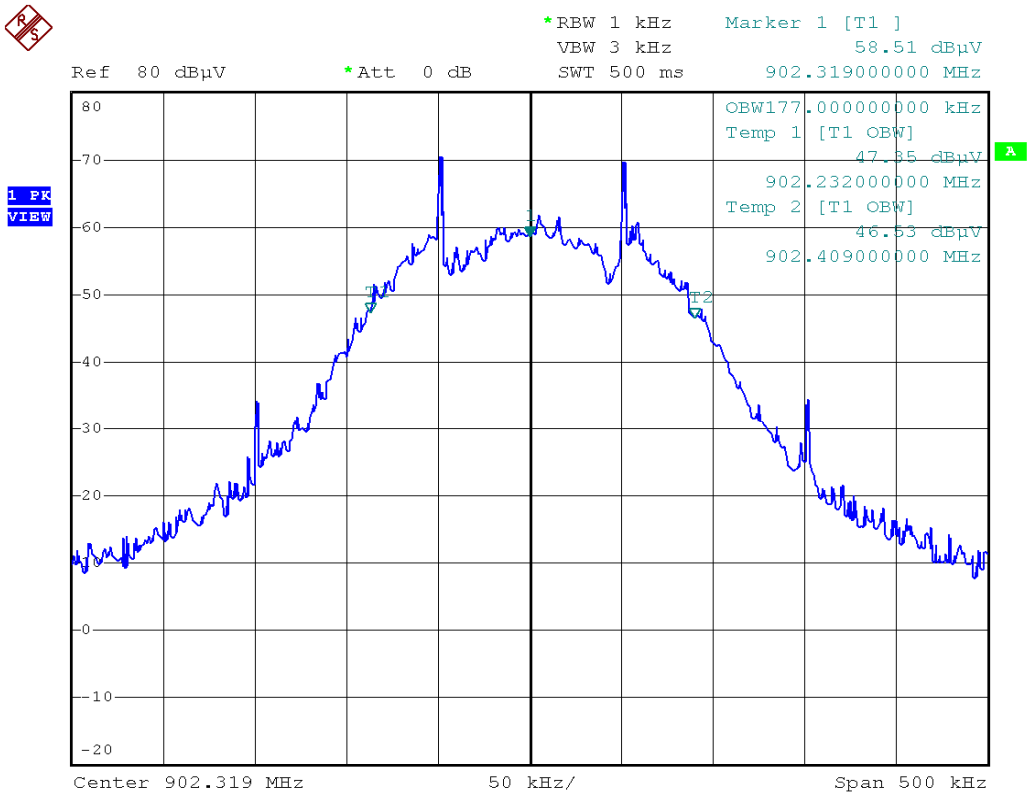


Figure 4.1.1: Measured BW (Channel L)

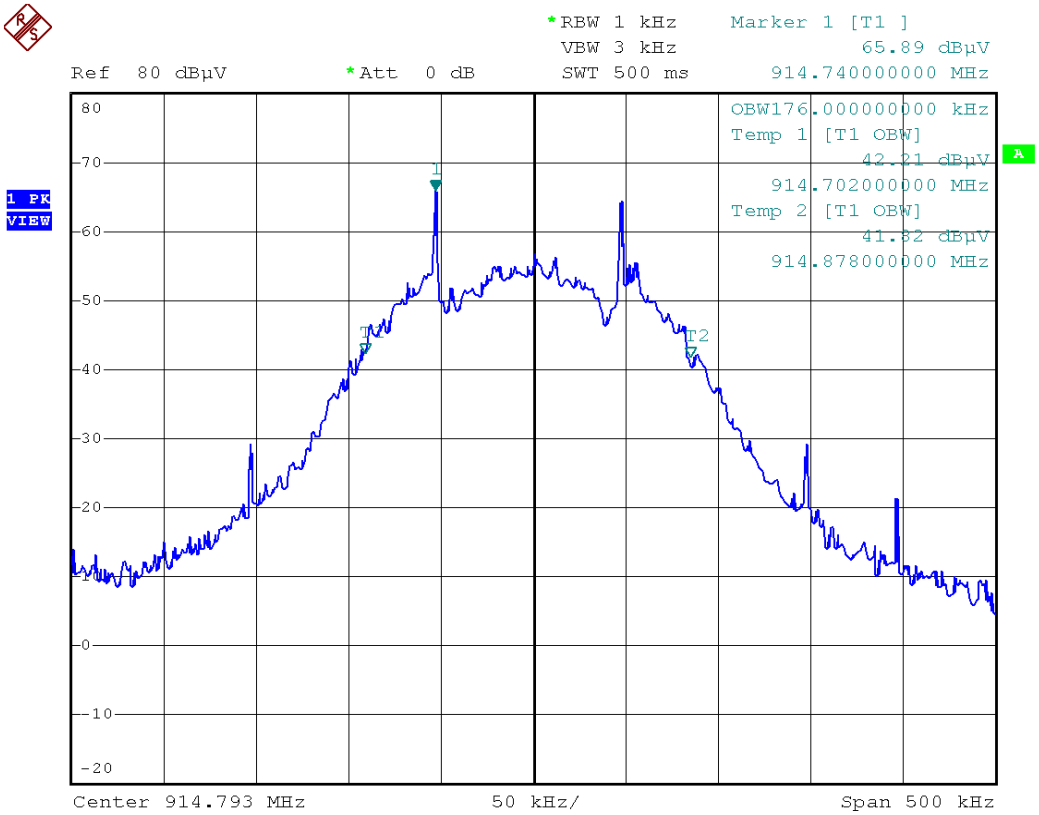


Figure 4.1.2: Measured BW (Channel M)

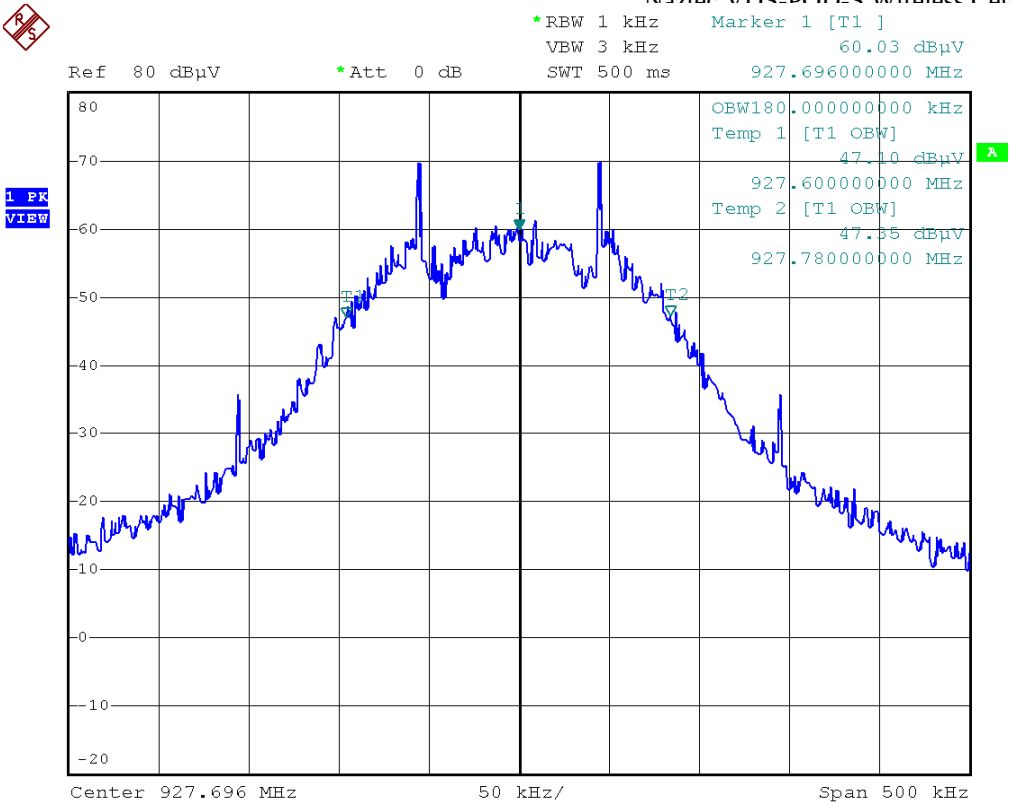


Figure 4.1.3: Measured BW (Channel H)

5.0 Band Edge Spurious Emissions

Band edge spurious emissions measurements were performed on the EUT to determine compliance to FCC 15.247(d) and RSS-210 A8.5.

5.2 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable, which allows 360-degree rotation. For measurements of the fundamental signal, a measurement antenna was positioned at a distance of 1 meter as measured from the closest point of the EUT. Rotating the EUT maximized the emissions.

The spectrum analyzer was set for peak detection using a 300 kHz resolution bandwidth. The span is set wide enough to show the band edge and the edge of the emission of the screen. Measurement is made at the band edge using the marker delta method while transmitting on the channels nearest the band edge to determine if the EUT meets the test criteria. A diagram showing the test setup is given as Figure 2.1.1.

5.3 Test Criteria

Clause Subject	Section Number	Required?
Field Strength of Radiated Spurious/Harmonic Emissions	15.205, 15.209	Yes

5.4 Test Results

EUT was found to be in compliance with applicable requirements.

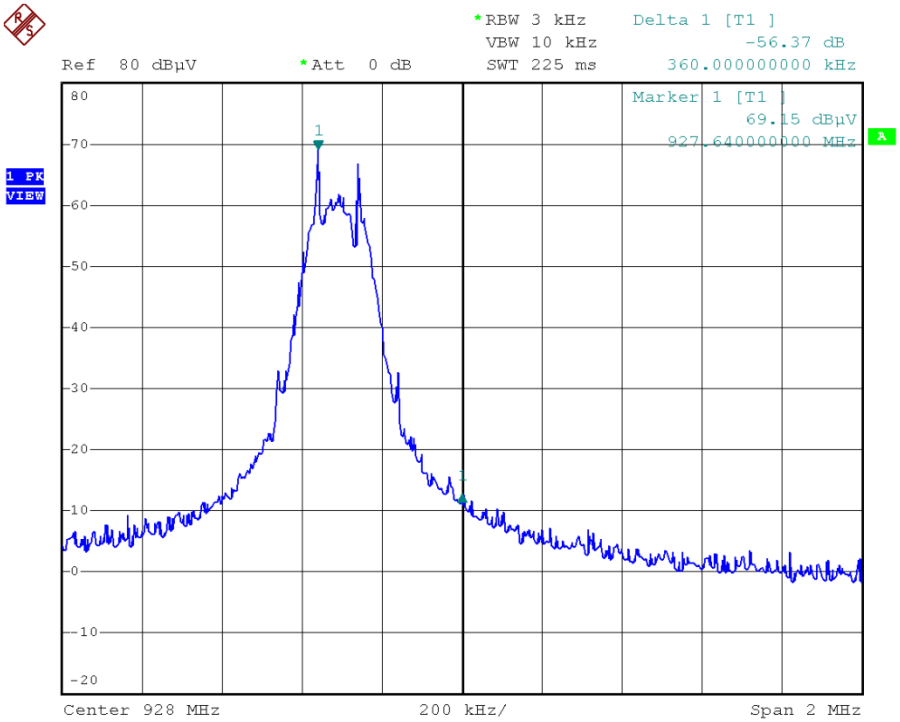


Figure 5.4.1: Band Edge, Channel H

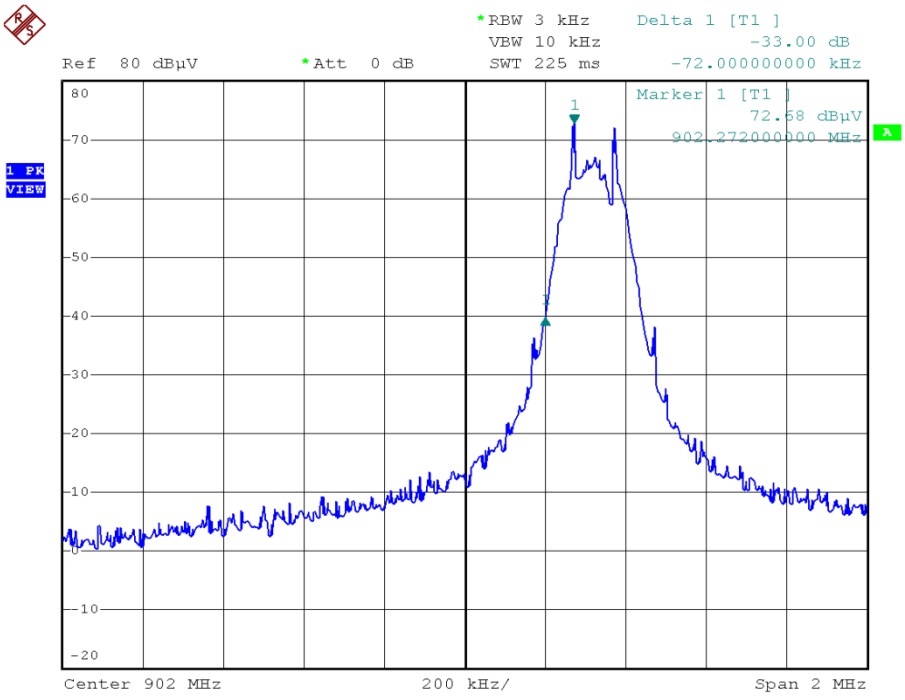


Figure 5.4.2: Band Edge, Channel L

6.0 Out of Band Spurious Emissions

Out of band spurious/harmonic emissions measurements were performed on the EUT to determine compliance to 47 CFR, Part 15.

6.2 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 10 meters from the measurement antenna.

Emissions below 1 GHz were measured with peak detection with a resolution bandwidth of 120 kHz and measured at a distance of 10 meters. Quasi-peak detection was used to determine compliance of the EUT if the peak did not meet the peak limit.

Harmonic emissions above 1 GHz peak were measured with peak detection, a resolution bandwidth of 1 MHz, and at a distance of 1 meter. If peak measurements exceeded average limits, the peak limit was applicable and duty cycle factor was then applied for average level calculation. Emissions were investigated up to the 10th harmonic of the transmitter fundamental.

Non-harmonic spurious emissions must satisfy the average limit and the peak limit (20 dB above average). A diagram showing the test setup is given as Figure 5.1.1.

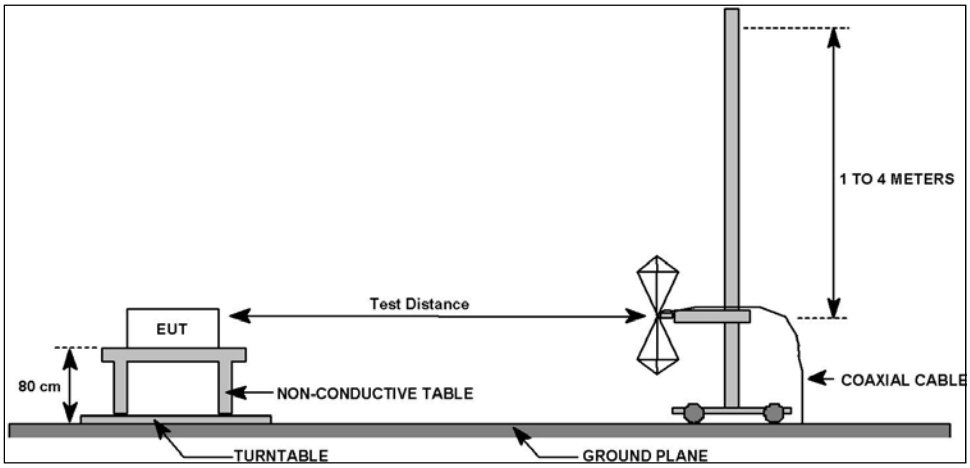


Figure 5.1.1: Field Strength of Spurious Emissions Test Setup

6.3 Test Criteria

Clause Subject	Section Number	Required?
Field Strength of Radiated Spurious/Harmonic Emissions	15.205, 15.209, RSS-210 A2.9(a) and (b)	Yes

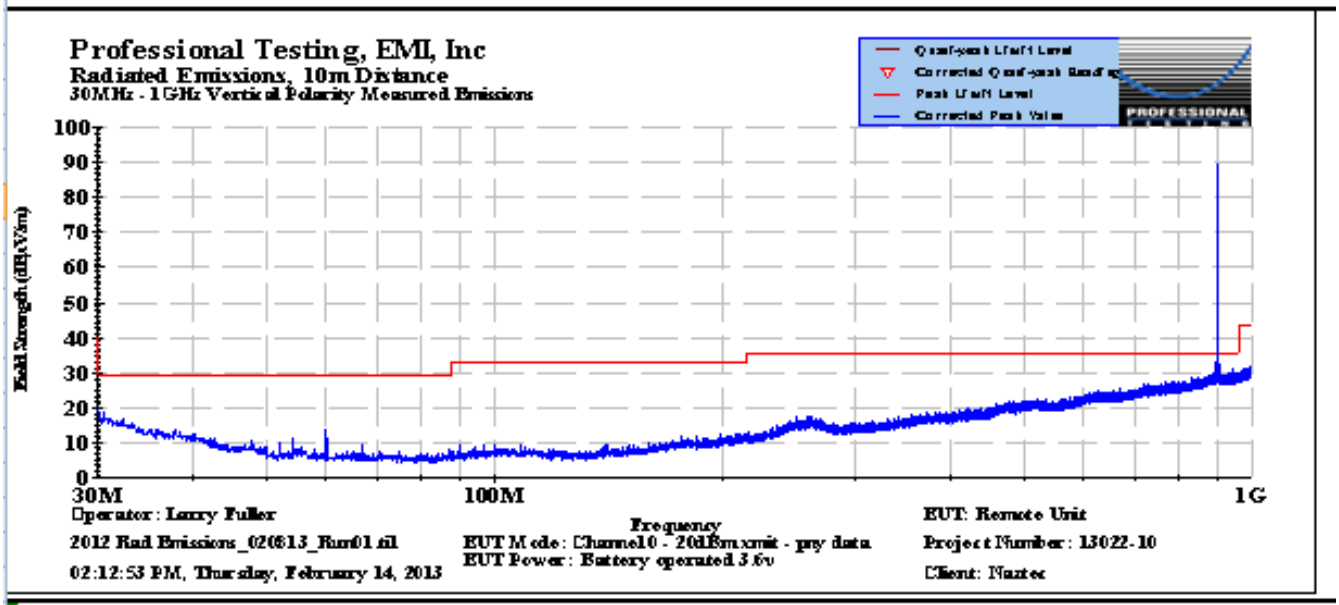
6.4 Test Results

Table 6.3.1: Radiated Spurious Emissions, Below 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.			
Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2013	EUT Serial #:	None
Customer:	Naztec	EUT Part #:	None
Project Number:	13022-10	Test Technician:	Larry Fuller/Eric Lifsey
Purchase Order #:		Supervisor:	Rob McCollough
Equip. Under Test:	Remote Unit	Witness' Name:	None

Radiated Emissions Test Results Data Sheet					Page: 1 of 1
EUT Line Voltage:	3.6	VDC	EUT Power Frequency:	N/A	N/A
Antenna Orientation:	Vertical		Frequency Range:	30MHz to 1GHz	
EUT Mode of Operation:			Channel 0 - 20dBm xmit - pny data		

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
902.394	10			Peak		89.60			



≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 6.3.2: Radiated Spurious Emissions, Below 1 GHz, Horizontal Polarity

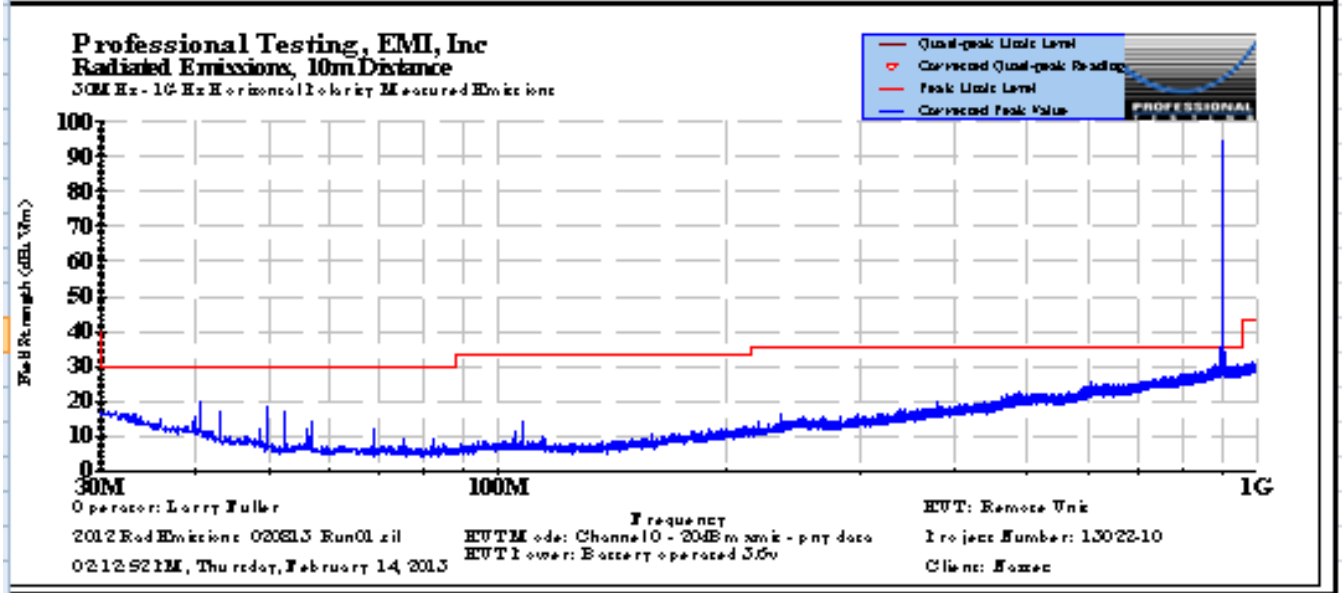
Professional Testing, EMI, Inc.

Test Method:	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).		
In accordance with:	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits		
Section:	15.209		
Test Date(s):	2/14/2013	EUT Serial #:	None
Customer:	Naztec	EUT Part #:	None
Project Number:	13022-10	Test Technician:	Larry Fuller/Eric Lifsey
Purchase Order #:		Supervisor:	Rob McCollough
Equip. Under Test:	Remote Unit	Witness' Name:	None

Radiated Emissions Test Results Data Sheet — Page: 1 of 1

EUT Line Voltage:	3.6 VDC	EUT Power Frequency:	N/A N/A
Antenna Orientation:	Horizontal	Frequency Range:	30MHz to 1GHz
EUT Mode of Operation:		Channel 0 - 20dBm xmit - pny data	

Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
902.273	10			Peak		94.6			



≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 6.3.3: Radiated Spurious Emissions, 1 to 25 GHz, Horizontal Polarity, Channel L

Professional Testing (EMI), Inc.

Radiated Emissions Measured Indoors, 1 Meters Distance, Antenna Polarized Horizontal

V 2.X

Client:	Naztec	Preamp:	1		
Test Date:	February 28, 2013	EUT:	Sensor		
Voltage:	Battery Powered	Serial #:	611		
Frequency:	n/a	Project #:	13022		
Technician:	Eric Lifsey	Test Type:	15.247	Class:	B

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency (GHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Margin With Duty Cycle Factor
1.804638	90	1	65.7	30.0	27.3	1.66	64.7	64	0.7	-19.3
2.706957	90	1	63.8	32.0	29.1	2.13	63.1	64	-0.9	-20.9
3.609276	120	1	60.9	31.4	32.6	2.70	64.7	64	0.7	-19.3
4.511595	45	1	56.7	32.0	33.3	3.04	61.1	64	-2.9	-22.9
5.413914	270	1	48.5	31.7	35.3	4.27	56.4	64	-7.6	-27.6
7.218552	0	1	48.9	31.1	37.1	4.34	59.2	64	-4.8	-24.8

Table 6.3.4: Radiated Spurious Emissions, 1 to 25 GHz, Vertical Polarity, Channel L

Professional Testing (EMI), Inc.

Radiated Emissions Measured Indoors, 1 Meters Distance, Antenna Polarized Vertical

V 2.X

Client:	Naztec	Preamp:	1		
Test Date:	February 28, 2013	EUT:	Sensor		
Voltage:	Battery Powered	Serial #:	611		
Frequency:	n/a	Project #:	13022		
Technician:	Eric Lifsey	Test Type:	15.247	Class:	B

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency (GHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Margin With Duty Cycle Factor
1.804638	160	1	70.1	30.0	27.3	1.66	69.1	64	5.1	-14.9
2.706957	90	1	69.4	32.0	29.1	2.13	68.7	64	4.7	-15.3
3.609276	270	1	64.9	31.4	32.6	2.70	68.7	64	4.7	-15.3
4.511595	200	1	61.3	32.0	33.3	3.04	65.7	64	1.7	-18.3
5.413914	180	1	51.2	31.7	35.3	4.27	59.1	64	-4.9	-24.9
6.316233	180	1	49.8	32.0	35.2	5.52	58.6	64	-5.4	-25.4
7.218552	160	1	53.4	31.1	37.1	4.34	63.7	64	-0.3	-20.3

Table 6.3.5: Radiated Spurious Emissions, 1 to 25 GHz, Horizontal Polarity, Channel M

Professional Testing (EMI), Inc.

Radiated Emissions Measured Indoors, 1 Meters Distance, Antenna Polarized Horizontal

V 2.X

Client:	Naztec	Preamp:	1		
Test Date:	February 28, 2013	EUT:	Sensor		
Voltage:	Battery Powered	Serial #:	611		
Frequency:	n/a	Project #:	13022		
Technician:	Eric Lifsey	Test Type:	15.247	Class:	B

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency (GHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Margin With Duty Cycle Factor
1.8298	90	1	66.1	30.0	27.4	1.67	65.2	64	1.2	-18.8
2.7447	270	1	62.3	32.0	29.3	2.15	61.7	64	-2.3	-22.3
3.6596	275	1	63.2	31.6	32.7	2.71	66.9	64	2.9	-17.1
4.5745	30	1	55.6	32.0	33.5	3.18	60.3	64	-3.7	-23.7
5.4894	275	1	45.6	32.0	35.5	4.39	53.5	64	-10.5	-30.5
6.4043	90	1	45	32.0	35.3	5.14	53.4	64	-10.6	-30.6
7.3192	45	1	50.7	31.3	37.2	4.49	61.1	64	-2.9	-22.9
8.2341	180	1	44.3	31.9	38.4	6.00	56.8	64	-7.2	-27.2
9.149	275	1	45.2	32.3	38.0	6.18	57.0	64	-7.0	-27.0

Table 6.3.6: Radiated Spurious Emissions, 1 to 25 GHz, Vertical Polarity, Channel M

Professional Testing (EMI), Inc.

Radiated Emissions Measured Indoors, 1 Meters Distance, Antenna Polarized Vertical

V 2.X

Client:	Naztec	Preamp:	1		
Test Date:	February 28, 2013	EUT:	Sensor		
Voltage:	Battery Powered	Serial #:	611		
Frequency:	n/a	Project #:	13022		
Technician:	Eric Lifsey	Test Type:	15.247	Class:	B

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency (GHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Margin With Duty Cycle Factor
1.8298	120	1	69.4	30.0	27.4	1.67	68.5	64	4.5	-15.5
2.7447	275	1	67	32.0	29.3	2.15	66.4	64	2.4	-17.6
3.6596	90	1	64.3	31.6	32.7	2.71	68.0	64	4.0	-16.0
4.5745	235	1	60.8	32.0	33.5	3.18	65.5	64	1.5	-18.5
5.4894	180	1	49.7	32.0	35.5	4.39	57.6	64	-6.4	-26.4
6.4043	120	1	47.8	32.0	35.3	5.14	56.2	64	-7.8	-27.8
7.3192	220	1	55	31.3	37.2	4.49	65.4	64	1.4	-18.6
8.2341	270	1	46	31.9	38.4	6.00	58.5	64	-5.5	-25.5
9.149	180	1	46.9	32.3	38.0	6.18	58.7	64	-5.3	-25.3

Table 6.3.7: Radiated Spurious Emissions, 1 to 25 GHz, Horizontal Polarity, Channel H

Professional Testing (EMI), Inc.

Radiated Emissions Measured Indoors, 1 Meters Distance, Antenna Polarized Horizontal

V 2.X

Client:	Naztec	Preamp:	1
Test Date:	February 28, 2013	EUT:	Sensor
Voltage:	Battery Powered	Serial #:	611
Frequency:	n/a	Project #:	13022
Technician:	Eric Lifsey	Test Type:	15.247 Class: B

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency (GHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Margin With Duty Cycle Factor
1.855392	90	1	67	30.0	27.6	1.69	66.3	64	2.3	-17.7
2.783088	45	1	65.4	32.0	29.5	2.17	65.0	64	1.0	-19.0
3.710784	90	1	60.6	31.8	32.8	2.71	64.3	64	0.3	-19.7
4.63848	120	1	52.7	32.0	33.7	3.31	57.7	64	-6.3	-26.3
5.566176	0	1	47.1	31.7	35.4	4.50	55.3	64	-8.7	-28.7
6.493872	270	1	48.3	32.0	35.3	4.76	56.4	64	-7.6	-27.6
7.421568	120	1	52	31.7	37.2	4.72	62.3	64	-1.7	-21.7
8.349264	270	1	44.8	31.6	38.3	5.95	57.5	64	-6.5	-26.5
9.27696	0	1	46	32.6	37.9	6.33	57.7	64	-6.3	-26.3

Table 6.3.8: Radiated Spurious Emissions, 1 to 25 GHz, Horizontal Polarity, Channel H

Professional Testing (EMI), Inc.

Radiated Emissions Measured Indoors, 1 Meters Distance, Antenna Polarized Vertical

V 2.X

Client:	Naztec	Preamp:	1
Test Date:	February 28, 2013	EUT:	Sensor
Voltage:	Battery Powered	Serial #:	611
Frequency:	n/a	Project #:	13022
Technician:	Eric Lifsey	Test Type:	15.247 Class: B

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

Frequency (GHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Margin With Duty Cycle Factor
0.927696				30.6	6.9	1.07				
1.855392	120	1	68.3	30.0	27.6	1.69	67.6	64	3.6	-16.4
2.783088	270	1	67.6	32.0	29.5	2.17	67.2	64	3.2	-16.8
3.710784	220	1	61.9	31.8	32.8	2.71	65.6	64	1.6	-18.4
4.63848	180	1	57.2	32.0	33.7	3.31	62.2	64	-1.8	-21.8
5.566176	120	1	50	31.7	35.4	4.50	58.2	64	-5.8	-25.8
6.493872	0	1	46.7	32.0	35.3	4.76	54.8	64	-9.2	-29.2
7.421568	270	1	54	31.7	37.2	4.72	64.3	64	0.3	-19.7
8.349264	120	1	46.8	31.6	38.3	5.95	59.5	64	-4.5	-24.5
9.27696	120	1	47.3	32.6	37.9	6.33	59.0	64	-5.0	-25.0

7.0 Frequency Hopping Parameter Measurements

Frequency Hopping measurements were performed on the EUT to determine compliance to FCC 15.247(a). FCC Public Notice DA 00-705 is referenced for this procedure.

7.1 Test Procedure

The EUT is configured for best signal/power then the frequency hopping parameters are measured.

Carrier Frequency Separation. This is measured with EUT in hopping mode. The spectrum analyzer is set to a span wide enough to observe at least 2 channels. Resolution bandwidth is set to at least 1% of span. The EUT is then set to hopping mode and max hold acquisition continues until a stable curve is obtained. Markers are used to measure center to center frequency separation.

Number of Hopping Frequencies. This is determined by allowing the EUT to operate in hopping mode while the spectrum analyzer collects the entire band, with some margin, in max-hold mode until a stable result was obtained with clearly discernible channels. The peaks for each hopping channel are then counted. The channel count will be used to determine other criteria.

Time of Occupancy (Dwell Time). This is measured with the spectrum analyzer centered on a hopping channel. The spectrum analyzer is set to 1 MHz resolution bandwidth and put in time domain (zero-span) mode. The transmit events are then observed in max-hold mode and the dwell time measured by placing markers. In addition, a video trigger is employed with a small negative offset to guarantee capture of the leading edge and thus the entire transmit signal.

7.2 Test Criteria

Section Reference	Parameter	Required?
15.247(a)	Hopping Frequency Separation, Number of Hopping Channels*, Channel Occupancy Time	Yes

*For 902-928 MHz band: Minimum 25 hopping channels. Under 50 channels limits power to 0.25 W, over 50 channels limits power to 1 W.

7.3 Test Results

Measured Carrier Frequency Separation	Measured Number of Hopping Frequencies	Measured Time of Occupancy (Dwell Time)
428 kHz	60 channels	1.496 msec

Measured time of occupancy (dwell time) for one total transmission =	1496 µs
Time Frame = 0.4 s * 60 hopping channels =	24000 ms
Measured time to return to one channel =	3763 ms
Total transmit events for one channel in the Time Frame, 24000 ms / 3763 ms =	6.378 events
Total time that one channel transmits within the 24 s Time Frame = 6.378 * 1496 µs =	**9.542 ms**

EUT was found to be in compliance with applicable requirements with 60 hopping channels in use. Recorded data is presented below.

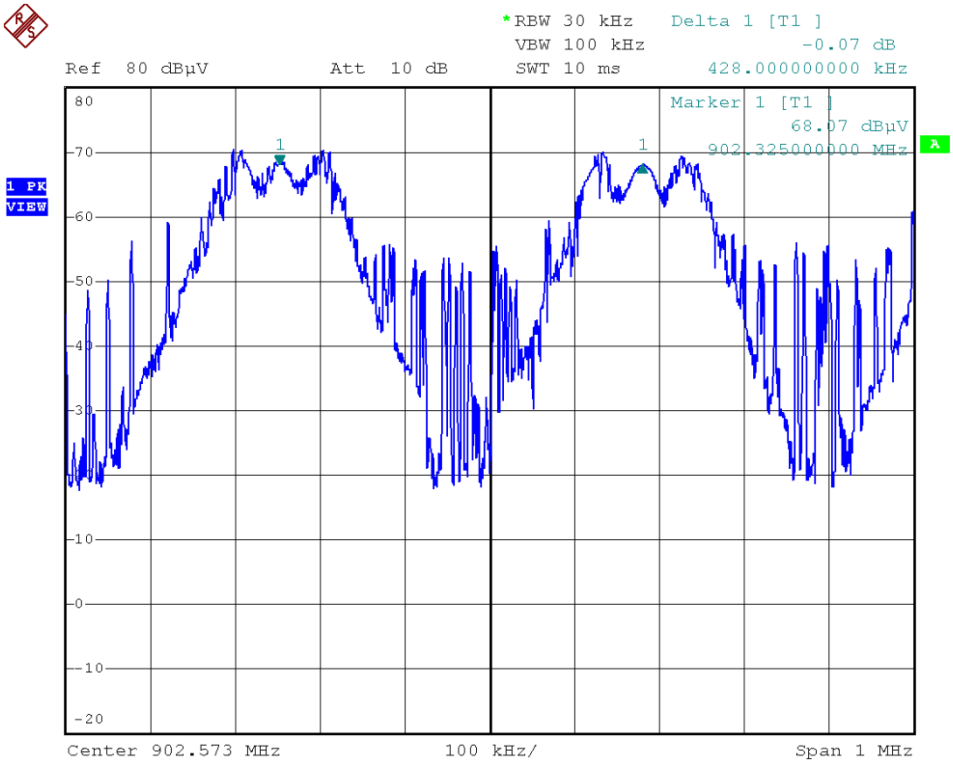


Figure 7.4.1: Carrier Frequency Separation

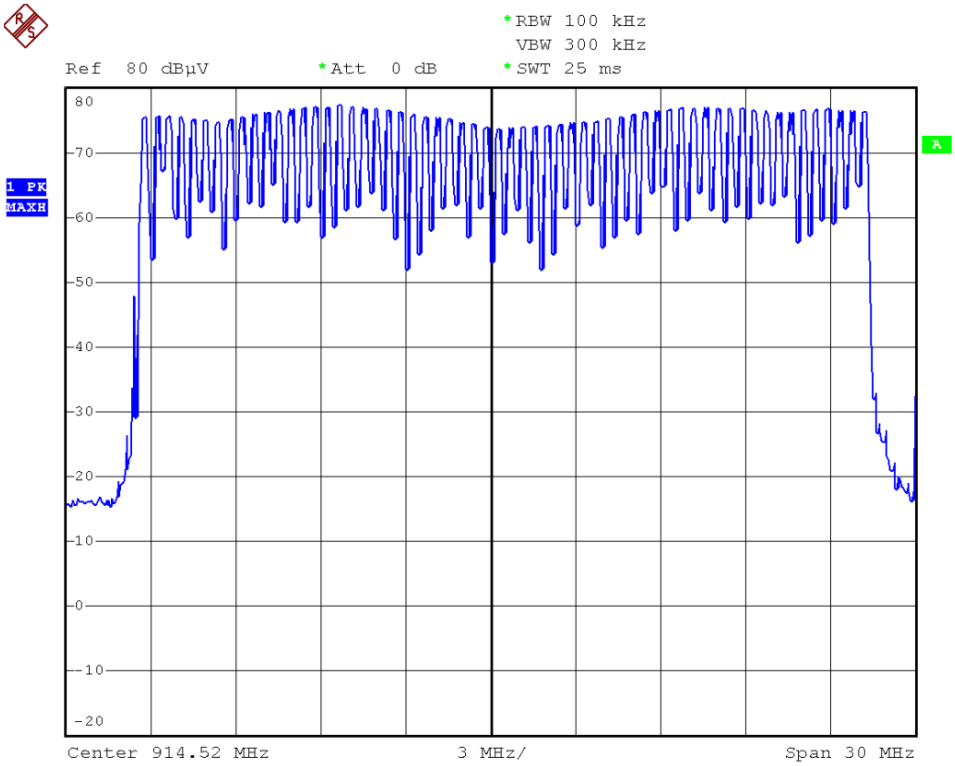


Figure 7.4.2: Number of Hopping Frequencies

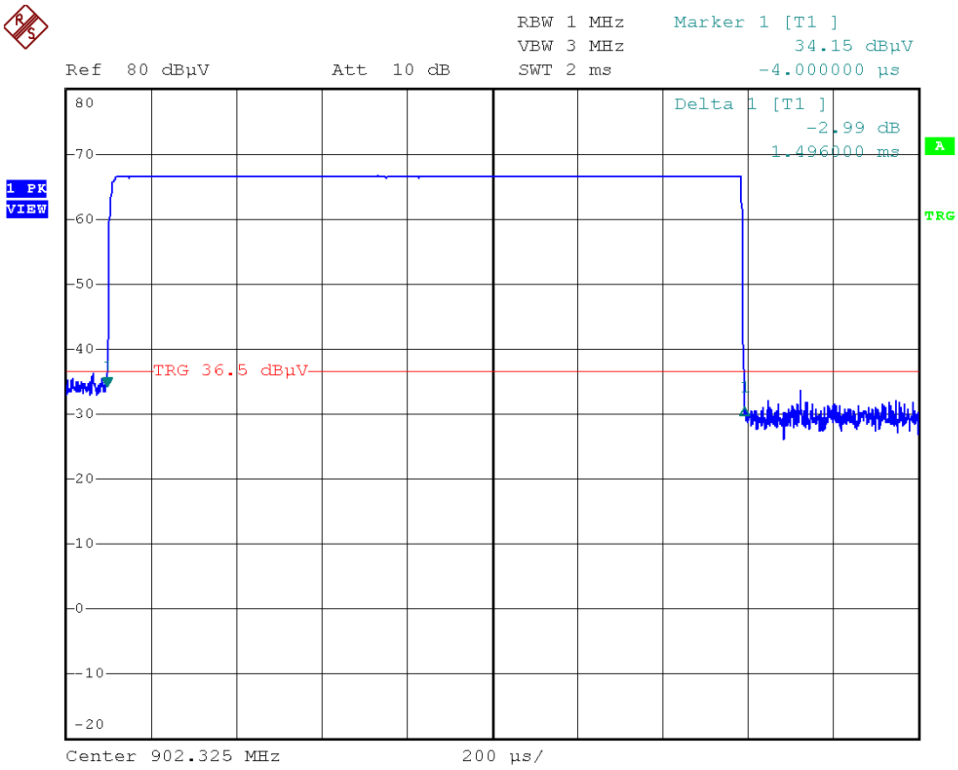


Figure 7.4.3: Time of Occupancy (Dwell Time)

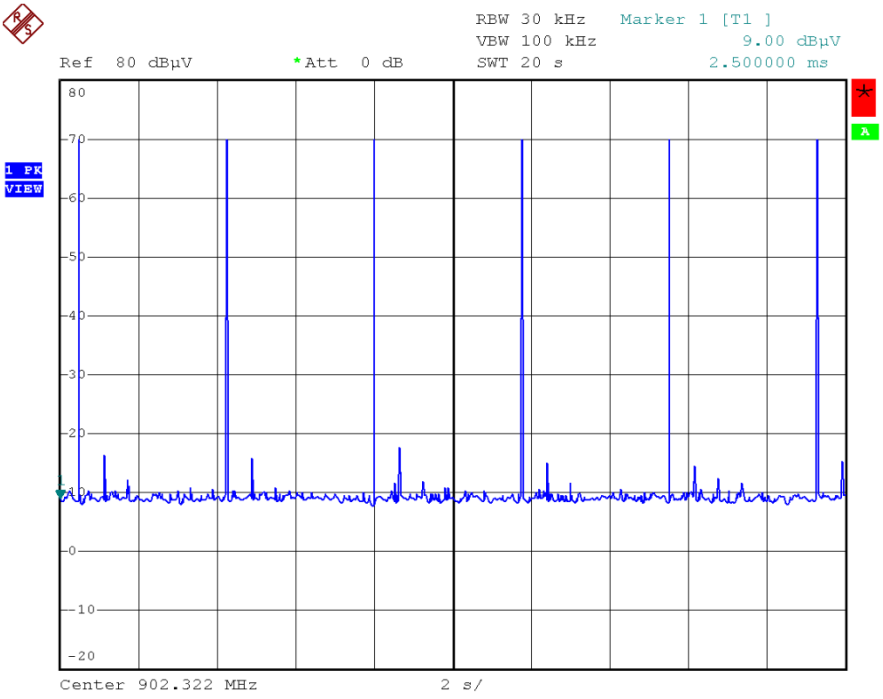


Figure 7.4.4: Hop Timing (Intervals)
3763 ms

8.0 Peak Output Power

Output power measurements were made on the EUT.

8.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 10 meters from the measurement antenna.

Emissions were measured with peak detection in a resolution bandwidth of 120 kHz.

Three operating channels were measured, the lowest, middle, and highest. The maximum recorded power for each channel is reported.

8.2 Test Criteria

The maximum output power is 1 W for devices operating in the frequency range 902-928 MHz MHz according to FCC 15.247 and when using at least 50 hopping channels*.

8.3 Test Results

EUT was found to be in compliance with applicable requirements. The highest recorded power was on the lowest channel or 902.3 MHz. The relevant peak output power criteria were selected based on measured channel count of 60. Field strength is adjusted by applying the maximum bandwidth factor to correct for measurement of a 180 kHz bandwidth signal in 120 kHz resolution bandwidth.

Channel	Measured Field Strength (V/m)	Restated in Log Terms (dBµV/m)	Bandwidth Factor Calculation dB	Corrected Power in Log Terms (dBµV/m)	Restated in Linear Terms in (V/m)
Low	0.0537	94.60	$=10*(\text{Log}_{10}(180/120))=1.761$	96.36	0.06577
Mid	0.0375	91.48	$=10*(\text{Log}_{10}(180/120))=1.761$	93.24	0.04592
High	0.0520	94.32	$=10*(\text{Log}_{10}(180/120))=1.761$	96.08	0.06369

Channel	Corrected Field Strength (V/m)	Distance (m)	EIRP Calculation	EIRP Result (W)	Peak Output Power Allowed (W)
Low	0.06577	10	$=(1/30)\ (0.06577\ \text{V/m} * 10\ \text{m})^2$	0.01442	1
Mid	0.04592	10	$=(1/30)\ (0.04592\ \text{V/m} * 10\ \text{m})^2$	0.00703	1
High	0.06369	10	$=(1/30)\ (0.06369\ \text{V/m} * 10\ \text{m})^2$	0.01352	1

Antenna polarity horizontal in each case.

9.0 Antenna Construction Requirements

The design was investigated for meeting the antenna construction requirements of the applicable rules.

9.2 Test Procedure

A direct examination of the antenna construction is performed and compared to a criterion that prevents wireless device antennas from being modified by end users in ways that would void their authorization to use the device.

9.3 Test Criteria

Clause Subject	Section Number	Required?
Antenna Construction	15.203	Yes

9.4 Test Results

The antenna is internal only to the device.

The antenna is a metal loop antenna designed by the manufacturer.

The antenna is connected via soldering only.

There is no antenna connector.

The design meets the requirements of the rules.

10.0 Equipment Lists

The design was investigated for meeting the antenna construction requirements of the applicable rules.

10.1 Equipment for Spurious Radiated Emissions Below 1 GHz

Professional Testing, EMI, Inc.			
Test Method:	**ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference,**		
In accordance with:	**FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits**		
Section:	**15.209**		
Test Date(s):	**2/15/2013**	**EUT Serial #:**	**0**
Customer:	**Universal Repeater**	**EUT Part #:**	**0**
Project Number:	**14426-10**	**Test Technician:**	**Eric Lifsey**
Purchase Order #:	**0**	**Supervisor:**	**Rob McCollough**
Equip. Under Test:	**SatMAX**	**Witness' Name:**	**Charlie Thompson**

Radiated Emissions Test Equipment List	
Tile! Software Version:	**4.2.A, May 23, 2010, 08:38:52 AM**
Test Profile:	**Radiated Emissions_Profile Version October 12, 2011**

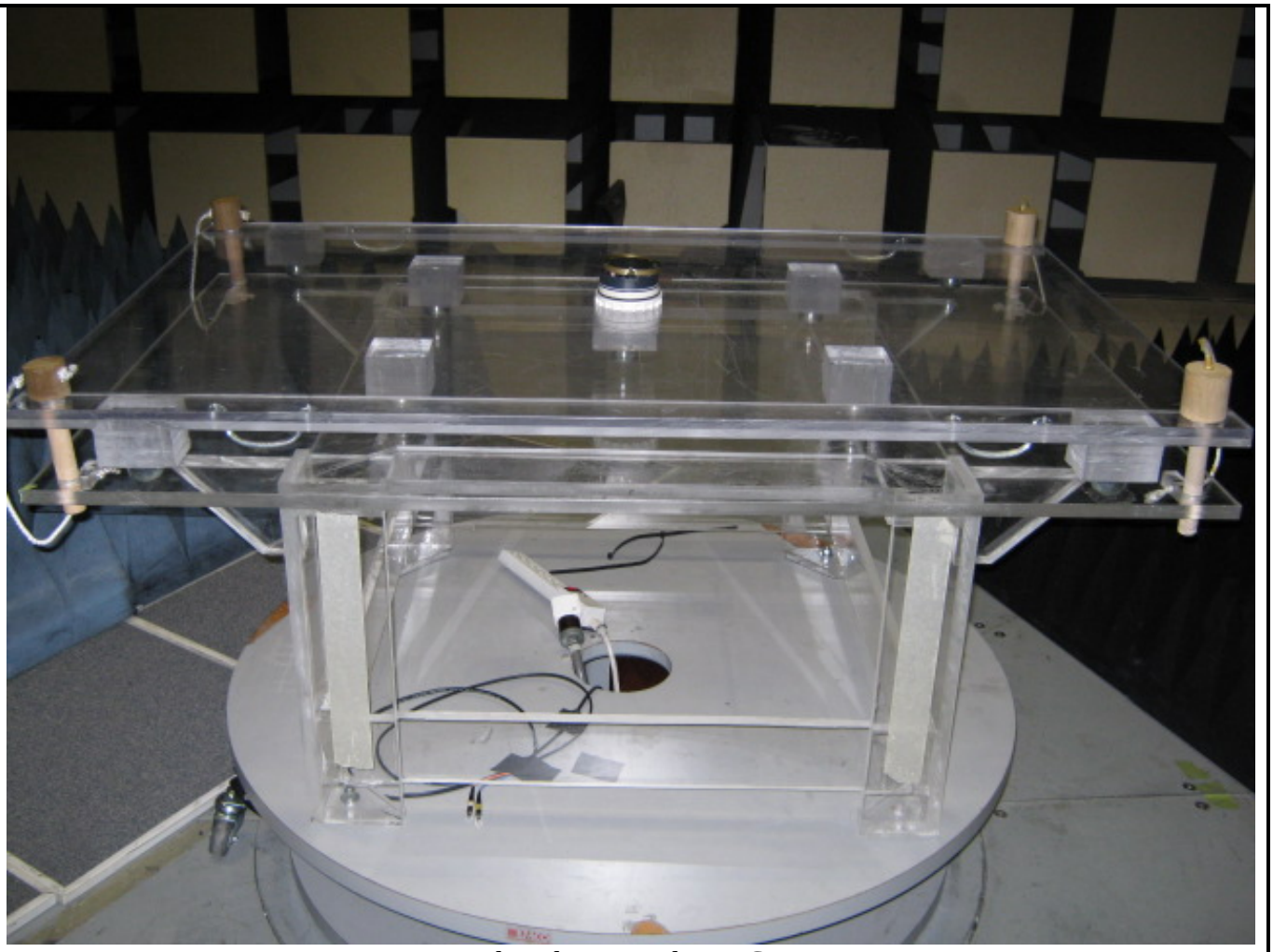
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Narda	3022	Coupler, Bi-Directional 1-4GHz	40063	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	00110313	2/4/2014
1930	Agilent	E4440A-239	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY45304903	6/19/2013
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
C027	N/A	LMR-400	Cable Coax, N-N, 0.6m	none	11/1/2013
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	HP	8491B-003	Attenuator, N, 3dB	21897	N/A
1594	Miteq	AFS44-00102650	Amplifier, 1-26.5GHz, 42dB	none	10/15/2013
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	11/26/2013
C030	N/A	LMR-400	Cable Coax, N-N, 2.5m	none	N/A

10.2 Equipment for Fundamental and Radiated Spurious Emissions Above 1 GHz

The following equipment was used to measure radiated output power, timings, bandwidth, and radiated spurious emissions.

Asset #	Manufacturer	Model #	Description	Calibration Due
0582	EMCO	3115	Ridge Guide Antenna	2014-02-14
1594	Agilent	83017A	Microwave Preamplifier (preamp 1)	2014-09-24
1342	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29
C059	Pasternack		Cable	2014-02-06
C249	Pasternack		Cable	2014-02-06
C250	Pasternack		Cable	2014-02-06
1542	AH Systems	SAS-572	Horn Antenna, Standard Gain, 20 dB	Not Required

10.3 Setup Photographs



Radiated Tests Below 1 GHz

Radiated Tests Above 1 GHz
And Other Tests: Timings, Bandwidth, Hopping Measurements

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report

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