CLASS II PERMISSIVE CHANGE TEST REPORT

Report Number: 101786411MPK-001
Project Number: G101786411
Report Date: August 29, 2014

Testing performed on the
Metropolitan Beacon System
Model: 100-0013-01
FCC ID: A4P-100-0013-01

to

FCC Part 90

for

NextNav, LLC

Test Performed by:	**Test Authorized by:**
Intertek	NextNav, LLC
1365 Adams Court	484 Oakmead Pkwy
Menlo Park, CA 94025, USA	Sunnyvale, CA 94085, USA

Prepared by: _____ **Date:** August 29, 2014
Minh Ly

Reviewed by: _____ **Date:** August 29, 2014
Krishna K Vemuri

Report No. 101786411MPK-001

Equipment Under Test:	Metropolitan Beacon System (MBS)
Trade Name:	NEXTNAV
Model No.:	100-0013-01
FCC ID:	A4P-100-0013-01
Applicant:	NextNav, LLC
Contact:	Waldemar Kunysz
Address:	484 Oakmead Parkway Sunnyvale, CA 94085
Country	USA
Tel. Number:	(408) 400-7850
Email:	wkunysz@nextnav.com
Applicable Regulation:	FCC Part 90
Test Site Location:	Intertek 1365 Adams Drive Menlo Park, CA 94025
Date of Test:	August 25 to August 27, 2014

We attest to the accuracy of this report:

Minh Ly	Krishna K Vemuri
EMC Project Engineer	EMC Senior Staff Engineer

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1.0 Introduction

The NextNav MBS beacon is a broadcast beacon that wirelessly transmits signals from fixed installations (typically co-located with other transmitters such as cellular transmitters) to help with determination of user location. In a given geographical area, several Box beacons are installed to provide the coverage and the geometry that is required for the 3D positioning trilateration by a MBS receiver. The NextNav Local beacons operate within the licensed ISM band (919.72-927.25 MHz) amongst themselves by transmitting the MBS signal in allocated time slots for a given frequency channel. The time slots are in 100ms multiples within one second.

As declared by the Applicant, the radio is identical to the radio which was previously tested per Intertek report # 101386112MPK-001 (FCC ID: A4P-100-0013-01). The original certified device operates only with 2.046 MHz Channel bandwidth channels between 920.773 - 926.227 MHz and 5.115 MHz Channel bandwidth on channel 924.692 MHz. The applicant is adding additional channel of the 5.115 MHz Channel Bandwidth on frequency 922.308 MHz by implement it with the software change. There is no hardware change and output power rating remains the same.

Therefore, according to KDB 178919 D01 Permissive Change Policy v05r04a, sec 4 a), Class II Permissive Change was performed to show compliance for the new frequency. Test includes: RF Output Power, Radiated Power, Emission Mask, and Spurious Emission for the 922.308 MHz.

This report is designed to show compliance of the radio with the requirements of FCC Part 90.

1.1 Summary of Tests

TEST	FCC REFERENCE	RESULTS
RF Power Output	2.1046	Complies
ERP	90.205(d)	Complies
Emission Masks	90.210	Complies
Out of Band Emissions at Antenna Terminals	2.1051, 90.210	Complies
Spurious Radiation	2.1053, 90.210	Complies.

2.0 General Description

2.1 Product Description

The NextNav MBS beacon is a broadcast beacon that wirelessly transmits signals from fixed installations (typically co-located with other transmitters such as cellular transmitters) to help with determination of user location. In a given geographical area, several Box beacons are installed to provide the coverage and the geometry that is required for the 3D positioning trilateration by a MBS receiver. The NextNav Local beacons operate within the licensed ISM band (919.72-927.25 MHz) amongst themselves by transmitting the MBS signal in allocated time slots for a given frequency channel. The time slots are in 100ms multiples within one second. There are various temporal modes of transmission:

1. Single transmission of 2.046 MHz band at center frequency of 926.227 MHz for 100 msec every 1 sec
2. Dual band transmission of 2.046 MHz (at 920.773 MHz) and 5.115 MHz (at 924.692 MHz) interleaved every 2nd sec (transm also for 100 msec)
3. Dual band transmission of 2.046 MHz (at 926.227 MHz) and 5.115 MHz (at 924.692 MHz) interleaved every 2nd sec (transm also for 100 msec)
4. Dual band transmission of 2.046 MHz (at 920.773 MHz) and 5.115 MHz (at 922.308 MHz) interleaved every 2nd sec (transm also for 100 msec)
5. Dual band transmission of 2.046 MHz (at 926.227 MHz) and 5.115 MHz (at 922.308 MHz) interleaved every 2nd sec (transm also for 100 msec)

Overview of the EUT

Radio Specifications	
Applicant	NextNav, LLC
Model No.	100-0013-01
Use of Product	Commercial deployment (MBS – Metropolitan Beacon System) to provide enhanced 3D positioning indoors, and outdoors in dense urban , semi-urban environment
Rated RF Output Power	30 Watts ERP
Frequency Ranges	902-928MHz
Type of Modulation	BPSK, CDMA, TDMA
Channel Bandwidth and Maximum Data Rate	2.046 MHz and 5.115 MHz, data rate: 1000 bps
Antenna & Gain	Commscope DB586-Y, Gain = 5.45 dBd Amphenol BCD-8707, Gain = 6.50 dBd Sinclair SC433-HF6LDF, Gain = 1.5 dBd Laird OD9-5, Gain = 2.85 dBd
Detachable Antenna	Yes
Manufacture Name & Address	NextNav, LLC 484 Oakmead Pkwy, Sunnyvale, CA 94085
EUT receive date:	August 25, 2014
EUT receive condition:	The EUT was received in good condition with no apparent damage. As declared by the Applicant it is identical to the production units.
Test start date:	August 25, 2014
Test completion date:	August 27, 2014

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Radiated emissions measurements were performed according to the procedures in ANSI C63.4. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the **"Data Sheet"** of this Application.

2.4 Test Facility

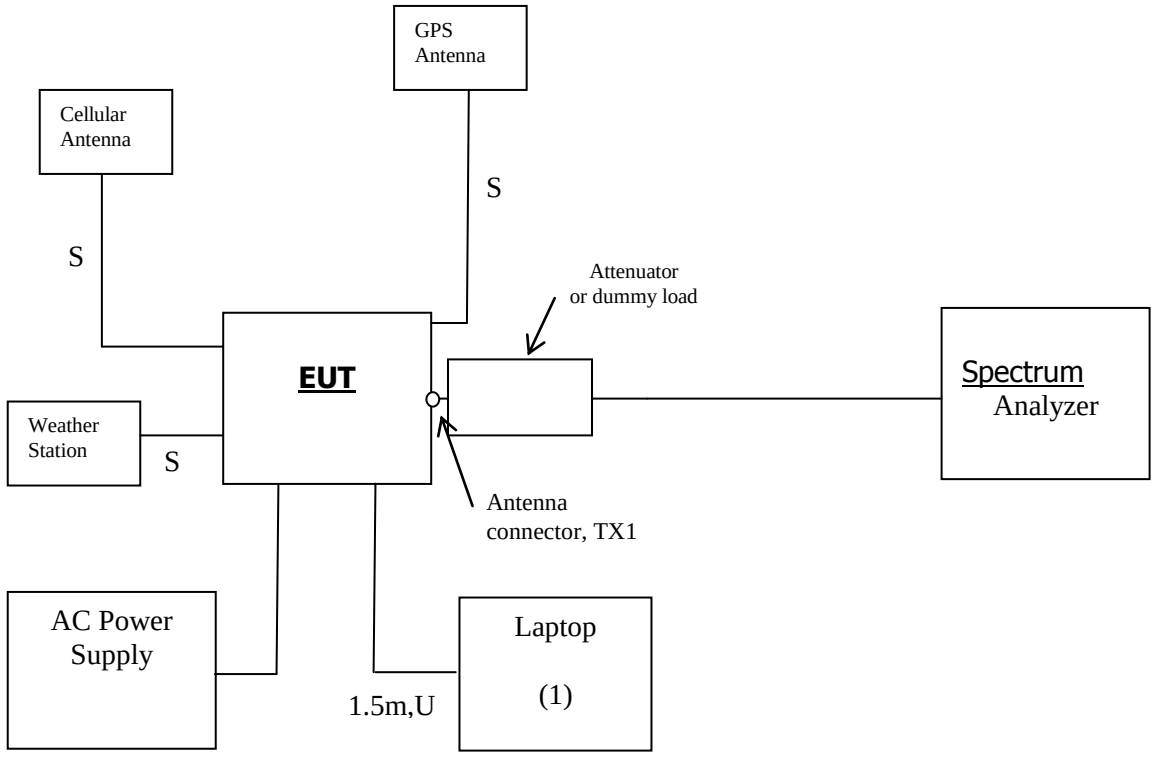
Radiated emission test site and conducted measurement facility used to collect the data is 10m semi-anechoic chamber located in Menlo Park, California. This test facility and site measurement data have been fully placed on file with the FCC.

3.0 System Test Configuration

3.1 Support Equipment

Item #	Description	Model No.	S/N
1	Dell Laptop	Vostro	Not Listed

3.2 Block Diagram of Test Setup



S = Shielded **U** = Unshielded	**F** = With Ferrite **m** = Length in Meters

During testing, the EUT was connected to a computer through an Ethernet cable. Test software loaded on the computer was adjusted to exercise the EUT with different mode and TX gain.

3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT is set to transmit full power.
The Metropolitan Beacon System was previously evaluated and complied with FCC Part 90, reference Intertek report # 101386112MPK-001 (FCC ID: A4P-100-0013-01). The original certified unit operates only with 2.046 MHz Channel bandwidth channels between 920.773 - 926.227MHz and 5.115 MHz Channel bandwidth on channel 924.692MHz. The applicant is adding additional channel of the 5.115 MHz Channel Bandwidth on frequency 922.308 MHz by implement it with the software change. There is no hardware change and output power rating remains the same.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was provided by the Applicant.

3.5 Mode of Operation during Test

During transmitter testing, the transmitter was setup to transmit at maximum RF power.

3.6 Modifications Required for Compliance

No modifications were installed by Intertek Testing Services during compliance testing in order to bring the product into compliance.

4.0 RF Power Output

FCC 2.1046

4.1 Test Procedure

The EUT RF output was connected as shown on the diagram in report section 3.2. The EUT was setup to transmit continuously the maximum power.

The spectrum analyzer was setup to measure the peak power. The attenuation and cable loss were added to the spectrum analyzer reading by using OFFSET function.

Measurements were performed on the new frequency at 922.308MHz. For dual band mode, a trigger is setup to measure the 5.115MHz channel.

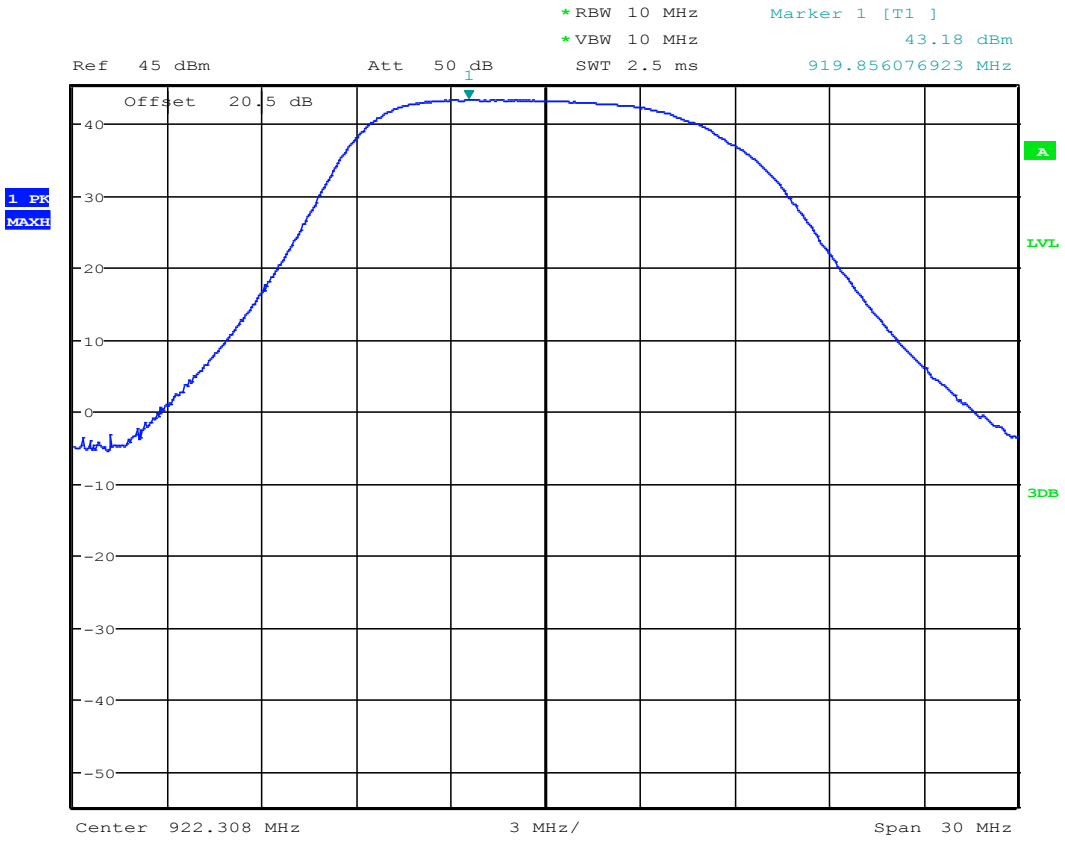
4.2 Test Equipment

Rohde & Schwarz FSU26 Spectrum Analyzer.

4.3 Test Results

Bandwidth (MHz)	Frequency (MHz)	Measured conducted Output Power (dBm)	Measured conducted Output Power (Watt)	Graph
5.115	922.308	43.18	20.8	4.1

Graph 4.1



Output Power

Date: 25.AUG.2014 16:39:49

5.0 Radiated Power

5.1 Requirement

FCC 90.205(d)

The maximum Effective Radiated Power (ERP) is 30 Watts or 44.77 dBm.

5.2 Test Procedure

The ERP was calculated by adding the antenna gain to the output power in dBm.

$ERP = P_{max} + G_{dBd}$

5.3 Test Equipment

None.

5.4 Test Results

According to the antenna list provided, the lowest antenna gain used with the EUT is 1.5 dBd; therefore, the maximum calculated peak radiated power is:

Bandwidth (MHz)	Frequency (MHz)	Measured Output Power (dBm)	Antenna Gain (dBd)	ERP (dBm)
5.115	922.308	43.2	1.5	44.7

Result	Complies

6.0 Emission Mask

FCC 90.210

6.1 Requirement

Equipment designed to operate in the frequency range 902 MHz – 928 MHz must meet the requirements of Emission Mask K as defined in FCC Part 90.210.

6.2 Test Procedure

The EUT RF output was connected as shown on the diagram in report section 1.3.2. The EUT was setup to transmit the maximum power in each mode.

The equation A = 16 + 0.4 (D-50) + 10logB (where B is the authorized bandwidth) was used to calculate the mask and entered into the spectrum analyzer. The maximum conducted power was used to set the reference level of the spectrum analyzer or the top of the mask.

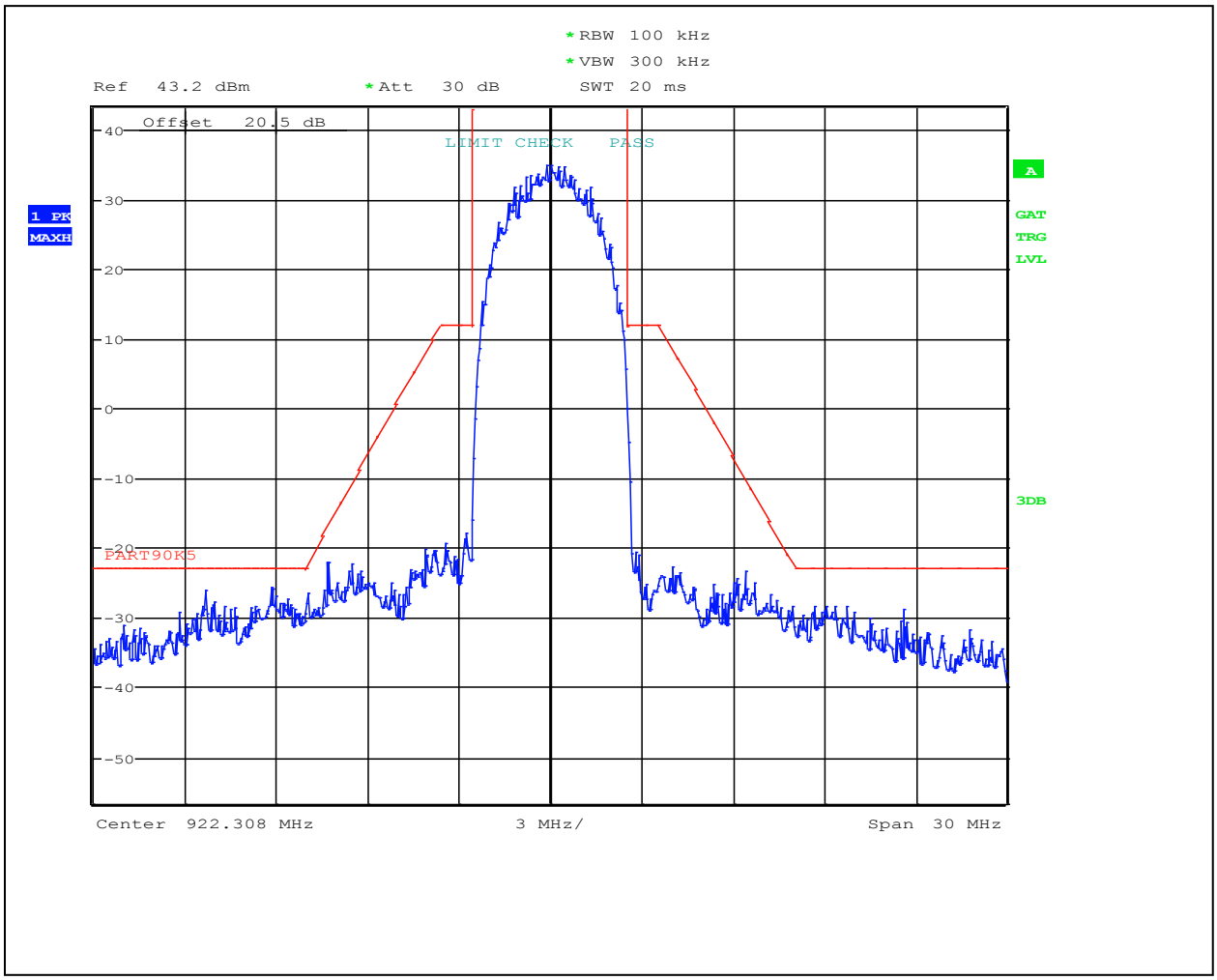
6.3 Test Equipment

Rohde & Schwarz FSU26 Spectrum Analyzer

6.4 Test Results

Complies	Refer to the following Graphs

Graph 6. 1


*RBW 100 kHz
*VBW 300 kHz
Ref 43.2 dBm
*Att 30 dB
SWT 20 ms
Offset 20.5 dB
LIMIT CHECK PASS
1 PK
MAXH
A
GAT
TRG
LVL
3DB
PART90K5
40
30
20
10
0
-10
-20
-30
-40
-50
Center 922.308 MHz
3 MHz/
Span 30 MHz

7.0 Spurious Emissions at Antenna Terminals

FCC 2.1051, 90.210

7.1 Requirement

Emission Mask K

The power of any emissions shall be attenuated below the transmitter output power, as specified in the equation: A = 16 + 0.4 (D-50) + 10log(B) (attenuation greater than 66 dB is not required).

Note:
Dual Band Mode: Attenuation of 66 dB corresponds to the level of -22.8 dBm for any out-of-band and spurious emissions. This worse-case limit was used for all conducted spurious emission measurements.

7.2 Test Procedure

The EUT RF output was connected as shown on the diagram in report section 3.2. The EUT was setup to transmit the maximum power.

For conducted measurements, the spectrum analyzer resolution bandwidth was set to 100 kHz. Peak detector is used for these measurements.

Sufficient scans were taken to show the spurious emissions up to 10th harmonic.

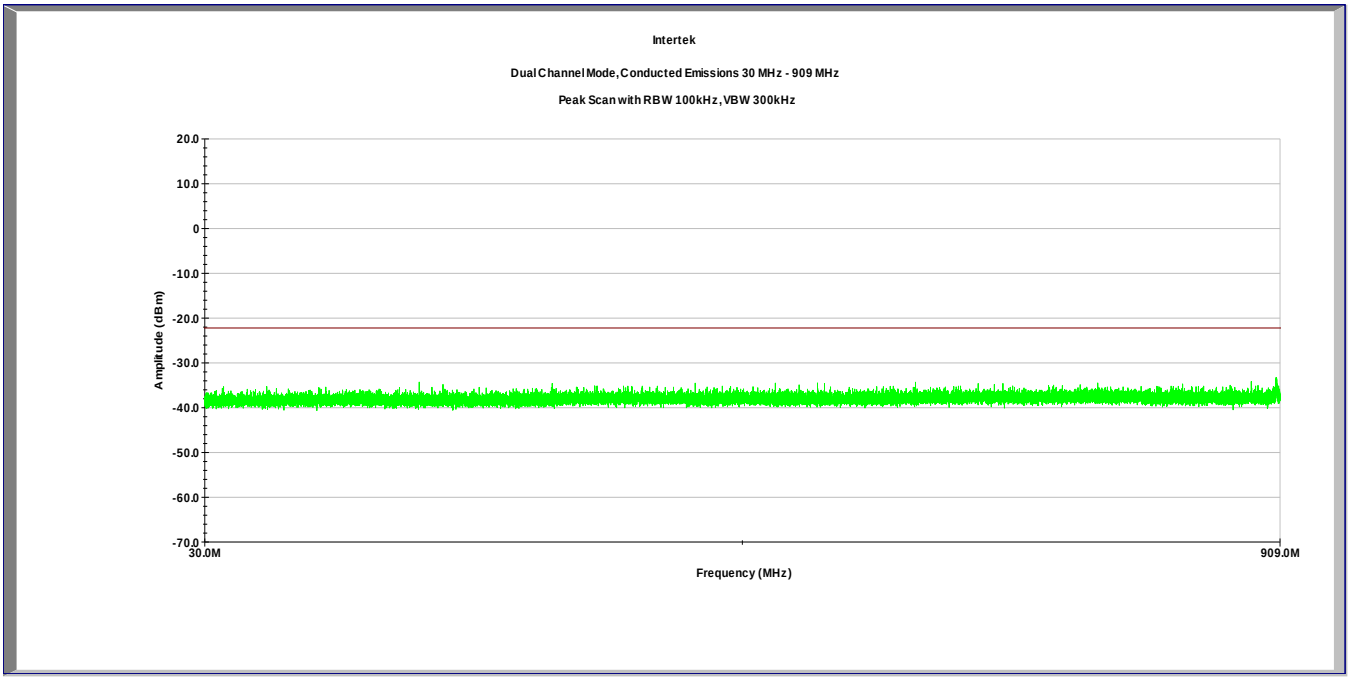
7.3 Test Equipment

Rohde & Schwarz FSU26 Spectrum Analyzer

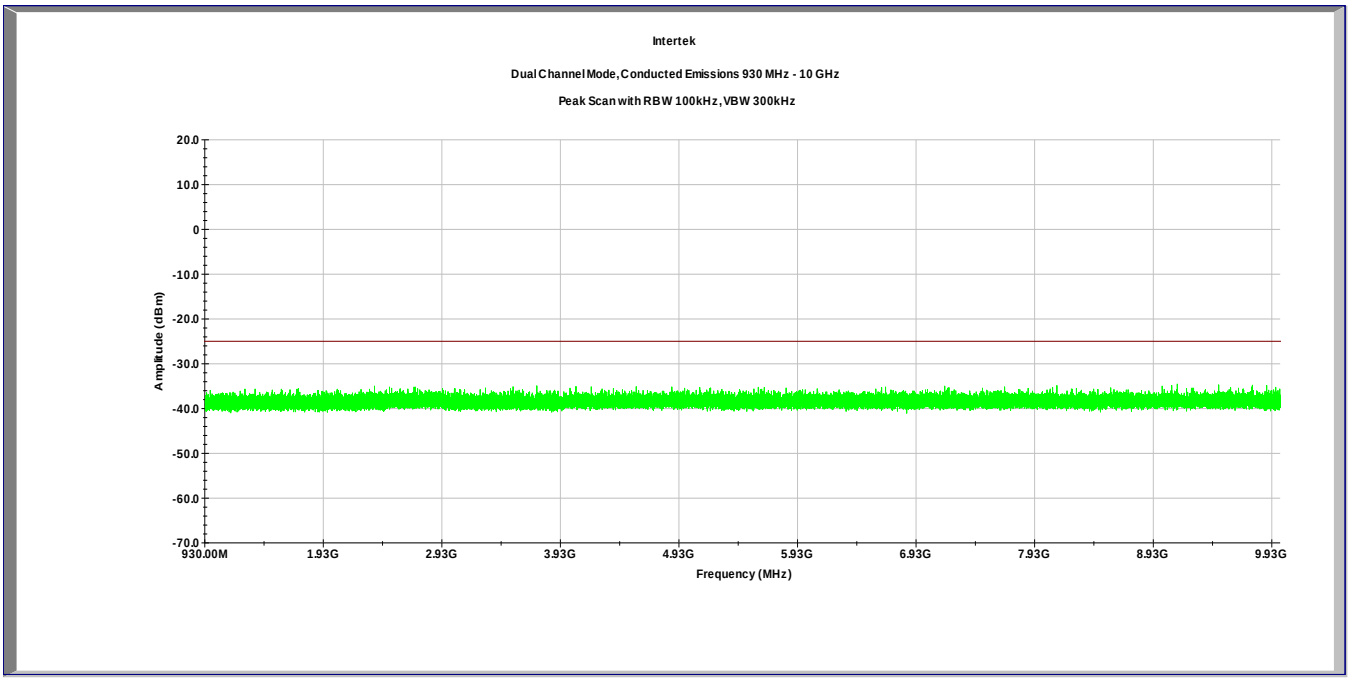
7.4 Test Results

Complies	Refer to the following Graphs

Graph 7. 2



Graph 7. 2



8.0 Spurious Radiation

FCC 2.1053, 90.210

8.1 Requirement

The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) on any frequency outside the frequency band by 66 dB.

Note:
Attenuation of 66 dB corresponds to the level of -22.8 dBm (Limit = Max power – 66) for any out-of-band and spurious emissions. The worse-case limit of -22.8 dBm was used for all dual band spurious emission measurements.

8.2 Test Procedure

The measurement antenna was placed at a distance of 10 meters for 30 MHz – 1 GHz and 3 meters for 1-10 GHz from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The frequency range up to 10th harmonic was investigated. The worst-case of emissions were reported.

During the spurious emission measurement, the antenna port of the EUT was terminated by 50 Ohms load. For spurious emissions attenuation, the limit was calculated and converted from dBm to dBuV/m to determine the worse-case margin. The substitution method was used to investigate at the highest peak in each frequency range (30 MHz – 1 GHz and 1 GHz – 10 GHz). The EUT was substituted by a reference antenna (Biconical antenna for 30MHz – 200MHz, log-periodic for 200 MHz – 1 GHz, or Horn antenna - above 1 GHz), connected to a signal generator. The signal generator output level ($\mathbf{V_g}$ in dBm) was adjusted to obtain the same reading as from EUT. The ERP at the spurious emissions frequency was calculated as follows.

$$ERP_{(dBm)} = \mathbf{V_g} + \mathbf{G}_{(dBd)} + \mathbf{CF}_{(dB)}$$

The spurious emissions attenuation is the difference between the ERP level at the fundamental frequency (see report section 5) and the level of the spurious emissions.

8.3 Test Equipment

Biconical Antenna
EMCO 3115 Horn Antennas
Rohde & Schwarz FSU26 Spectrum Analyzer
50ohm load

8.4 Test Results

Spurious Radiated Emissions

	Intertek Testing Services							
	Radiated Spurious Emissions 30 MHz - 10000 MHz, Vertical							
Operator: ML					Model Number: 100-0013-01			
August 26, 2014					Company: NextNav LLC			
Frequency (MHz)	**Peak FS dB(uV/m)**	**Limit@3m dB(uV/m)**	**Margin dB**	**RA dB(uV)**	**CF dB**	**AG dB**	**DCF dB**	**AF dB(1/m)**
60.167	45.1	72.4	-27.3	55.6	0.9	32.1	10.5	10.2
119.757	46.6	72.4	-25.8	55.3	1.2	32.0	10.5	11.6
706.478	49.2	72.4	-23.2	48.5	3.1	32.3	10.5	19.4
707.092	52.0	72.4	-20.4	51.3	3.1	32.3	10.5	19.4
709.97	51.2	72.4	-21.2	50.6	3.1	32.3	10.5	19.3
920.751	53.8	72.4	-18.6	48.9	3.6	31.5	10.5	22.3
1200.0	39.8	72.4	-32.6	46.5	3.0	34.3	0	24.6
3536.5	46.2	72.4	-26.2	45.5	5.2	35.1	0	30.6
5961.5	47.4	72.4	-25.0	39.5	6.9	34.2	0	35.3
6605.6	45.9	72.4	-26.5	36.3	7.3	33.9	0	36.2
9935.73	49.5	72.4	-22.9	35.7	9.4	33.9	0	38.3

	Intertek Testing Services							
	Radiated Spurious Emissions 30 MHz - 10000 MHz, Horizontal							
Operator: ML					Model Number: 100-0013-01			
August 26, 2014					Company: NextNav LLC			
Frequency (MHz)	**Peak FS dB(uV/m)**	**Limit@3m dB(uV/m)**	**Margin dB**	**RA dB(uV)**	**CF dB**	**AG dB**	**DCF dB**	**AF dB(1/m)**
120.275	42.1	72.4	-30.3	50.9	1.2	32.0	10.5	11.7
695.226	44.0	72.4	-28.4	42.2	3.0	32.3	10.5	19.8
708.774	44.3	72.4	-28.1	42.2	3.1	32.3	10.5	19.3
920.783	63.5	72.4	-8.9	57.1	3.6	31.5	10.5	22.3
922.95	58.7	72.4	-13.7	52.2	3.6	31.4	10.5	22.2
923.079	57.5	72.4	-14.9	51.0	3.6	31.4	10.5	22.2
1050.25	40.6	72.4	-31.8	48.1	2.8	34.3	0	23.8
1200.0	42.8	72.4	-29.6	49.5	3.0	34.3	0	24.6
7422.67	47.8	72.4	-24.6	36.1	7.8	33.5	0	37.4
8325.33	47.9	72.4	-24.5	35.9	8.4	33.8	0	37.5
9297.47	49.1	72.4	-23.3	35.8	9.1	33.9	0	38.0

Substitution Method

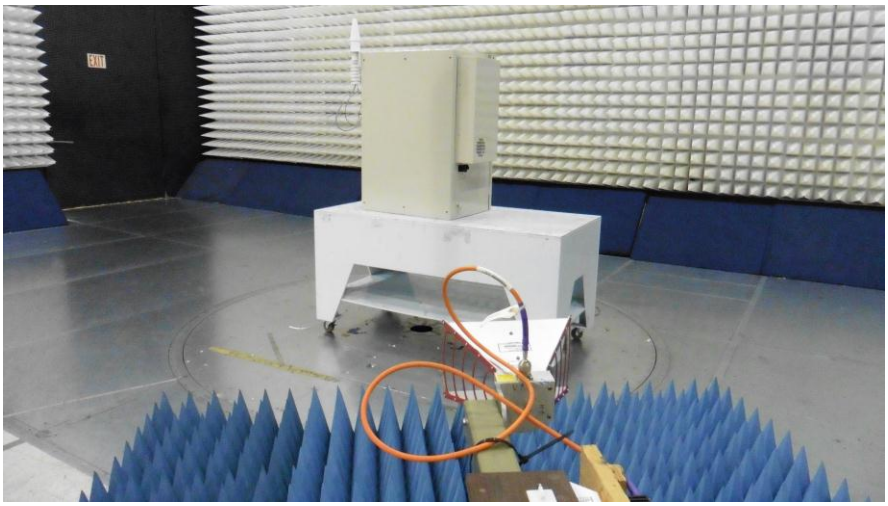
Frequency	Raw Amplitude	Signal Generator Output	Substitute Antenna Gain	CF	ERP*	ERP Limit	ERP Margin
MHz	dB(µV)	V_g dBm	(dBd)	(dB)	dBm	dBm	dB
920.783	57.1	-47.4	3.56	1.2	-45.0	-22.8	-22.2
1200.00	49.5	-57.8	4.45	1.2	-54.6	-22.8	-31.8

* ERP is calculated as: $ERP_{(dBm)} = \mathbf{V_{g(dBm)} + G_{(dBd)} - CF}$ (dB)

Result	Complies

8.5 Test Setup Photographs

Radiated Emission Test Setup



9.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Serial #	Cal Int	Cal Due
Spectrum Analyzer	Rohde & Schwarz	FSU	200482	12	12/11/14
Bi-Log Antenna	Teseq	CBL 6111D	31222	12	11/14/14
Horn Antenna	ETS-Lindgren	3115	00126795	12	11/14/14
Signal Generator	Rohde & Schwarz	SMR40	100445	12	08/30/14
Horn Antenna	EMCO	3115	9107-3712	12	12/17/14
Pre-Amplifier	Sonoma Instrument	310	185634	12	12/20/14
Pre-Amplifier	Miteq	AMF-4D-001180-24-10P	799159	12	09/27/14
Log-periodic Antenna	EMCO	3148	9904-1062	12	02/18/15

Calibration not required

10.0 Document History

Revision/ Job Number	Writer Initials	Reviewer Initials	Date	Change
1.0 / G101786411	ML	KK	August 29, 2014	Original document