EMISSIONS TEST REPORT FOR A LOW POWER TRANSMITTER

I. GENERAL INFORMATION

Requirement:	FCC
Test Requirements:	FCC Part 15
Applicant:	Silver Spring Networks 575 Broadway Street Redwood City, CA 94063
FCC ID:	**OWS-NIC714**
IC:	**5975A-NIC714**
Model No.:	NIC414
Application type:	Class 2 permissive change

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Silver Spring Networks (SSN) model NIC414 is a radio module for electric power meter communications use. The module incorporates a 900 MHz frequency hopping spread spectrum mesh network radio and a 2.4 GHz DTS radio.

This report is for a Class 2 permissive change to add a 2.4 GHz FHSS function to the module. No changes will be made to the module hardware, activation of the 2.4 GHz FHSS function is via by software only.

III. TEST DATES AND TEST LOCATION

Testing was performed on various dates between April and September 2013.

Radiated emissions:

BACL Laboratories
1274 Anvilwood Ave.
Sunnyvale, CA 94089

Antenna port conducted tests were performed at Silver Spring Networks and at BACL.

T.N. Cokenias
EMC Consultant/Agent for Silver Spring Networks

15 September 2013

15.203 Antenna connector requirement

The EUT uses a custom permanently attached integral antenna, a special sheet metal antenna manufactured by Silver Spring Networks for electric meters. There is also an optional external antenna that can be used with this radio.

Antenna description	Mfr.	Model No.	Gain
Built-in sheet metal electric meter	SSN	n/a	1.2 dBi at 915 MHz 5.6 dBi at 2.4 GHz
External monopole antenna (omni)	SSN		3 dBi at 915 MHz 4 dBi at 2.4 GHz

TEST PROCEDURES

All tests were performed in accordance with the applicable procedures called out in the following documents, unless otherwise noted:

FCC 47CFR15

RSS-210 Issue 8: Low power license exempt radio frequency devices (December 2010)
RSS-212: Test Facilities and Test Methods for Radio Equipment

ANSI C63.4 – 2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

Test Equipment

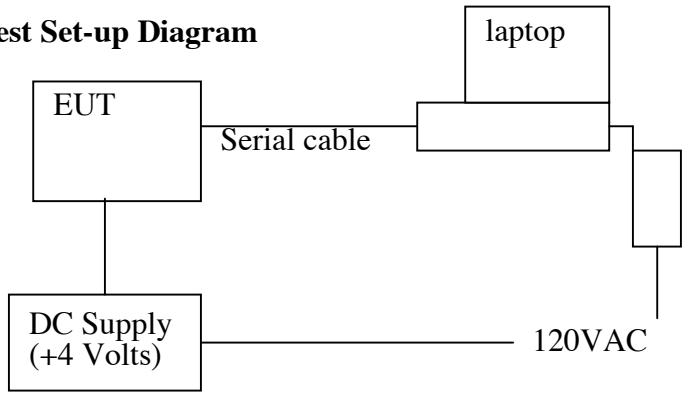
Manufacturer	Description	Model No.	Serial No.	Calibration Due
Agilent	Spectrum Analyzer	E4446A	US44300386	2013-09-29
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Bilog Antenna	JB3	A0020106-3	2014-06-18
ARA	Horn antenna	DRG-118A	1132	2014-1-29
Mini-Circuits	Pre Amplifier	ZVA-183-S	667400960	2014-05-09

Silver Spring Networks

Equipment	Mfr	Model	Serial No.	Cal Due
Spectrum Analyzer	Agilent	E4405B	MY45113391	01/23/14
Spectrum Analyzer	Agilent	N9030A	MY49430856	01/21/14

BACL

Test Set-up Diagram



Support Equipment

Equipment	Mfr	Model	Asset No.
DC Power Supply	Agilent	E3610A	2844
Laptop PC	Dell	PP01L	TW-0791UH1280-OC9-6558
AC/DC adapter	CUI Inc.	DSA-60W-20	2607HB

2.4 GHz FREQUENCY HOPPING SPREAD SPECTRUM RADIO EMISSIONS

Two transmit speeds are available, 250 kbps and 500 kbps. Radiated spurious emissions tests were performed for both the internal antenna and the external antenna. Worst-case radiated spurious emissions were for 250 kbps. The same number of channels are used for either 250 kbps or 500 kbps operation.

Worst-case band edged data was for 500 kbps operation (wider occupied band width) and is presented below.

TEST RESULTS

Radiated Test Set-up, 30 MHz-25 GHz

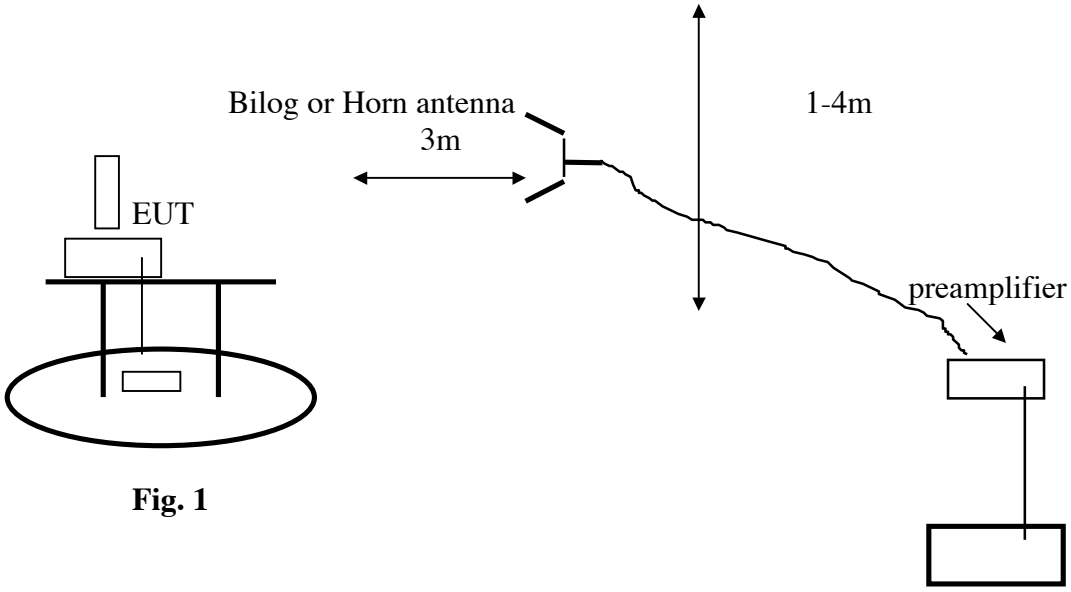


Fig. 1

Test Procedures

Radiated emissions generated by the transmitter portion of the EUT were measured.

1. The EUT was placed on a wooden table resting on a turntable on the test site. The search antenna was placed 3m from the EUT. The EUT antenna was mounted in the with the EUT TX antenna pointed directly to the search antenna.

2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.

3. Emissions were investigated to the 10^{th} harmonic of the fundamental.

4. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

Test Results: Worst-case results for radiated spurious are presented (250 kbps data rate). Refer to data sheets below. Restricted band emissions meet 54 dBuV/m. Other undesired emissions from the transmitter meet the -20 dBc requirement in 15.247(d).

15.205 Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505 (1)	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	
13.36 - 13.41	322 - 335.4		

15.209 General Field Strength Limits

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

Company Name: Silver Spring Networks
Project Number:T1308302
Tester: Bo Li
Date: 2013-08-30 and 2013-09-04
Above 1G at (Chamber3)

Horn Antenna: ARA DRG-118A
Amplifier: mini circuit ZVA-183-S
Spectrum Analyzer: E4446A, US44300386
Bilog Antenna: Sunol JB3 a020106-3
cable: SPS-2303-3840-SPS 32 feet, chamber 3 below 1 Ghz cable

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2400.8 MHz, measured at 3 meters, GFSK Modulation, 250 kbps data rate, Internal Antenna, PLS=15, MAC:0013500200A6FF39, Part Number: 174-0396 rev 07											
4801.6	42.05	327	103	V	33.027	4.56	27.7	51.937	74	-22.063	Peak
4801.6	40.6	289	127	H	33.027	4.56	27.7	50.487	74	-23.513	Peak
4801.6	39.1	327	103	V	33.027	4.56	27.7	48.987	54	-5.013	Ave
4801.6	36.98	289	127	H	33.027	4.56	27.7	46.867	54	-7.133	Ave
7202.4	38.14	130	268	V	37.633	5.49	27.58	53.683	74	-20.317	Peak
7202.4	36.15	39	113	H	37.633	5.49	27.58	51.693	74	-22.307	Peak
7202.4	33.56	130	268	V	37.633	5.49	27.58	49.103	54	-4.897	Ave
7202.4	28.73	39	113	H	37.633	5.49	27.58	44.273	54	-9.727	Ave
Middle channel 2440 MHz measured at 3 meters GFSK Modulation Internal Antenna, 250 kbps data rate, PLS=15, MAC:0013500200A6FF39 Part Number: 174-0396 REV 07											
4880	39.76	168	123	H	33.27	4.54	27.67	49.9	74	-24.1	Peak
4880	36.01	168	123	H	33.27	4.54	27.67	46.15	54	-7.85	Ave
4880	43.28	303	100	V	33.27	4.54	27.67	53.42	74	-20.58	Peak
4880	40.26	303	100	V	33.27	4.54	27.67	50.4	54	-3.6	Ave
7320	35.65	111	100	H	35.89	5.57	27.51	49.6	74	-24.4	Peak
7320	26.72	111	100	H	35.89	5.57	27.51	40.67	54	-13.33	Ave
7320	36.97	168	134	V	35.89	5.57	27.51	50.92	74	-23.08	Peak
7320	30.92	168	134	V	35.89	5.57	27.51	44.87	54	-9.13	Ave
12200	30	0	100	H	38.99	7.89	26.99	49.89	74	-24.11	Peak
12200	20	0	100	H	38.99	7.89	26.99	39.89	54	-14.11	Ave
12200	30	0	100	V	38.99	7.89	26.99	49.89	74	-24.11	Peak
12200	20	0	100	V	38.99	7.89	26.99	39.89	54	-14.11	Ave
High Channel 2472.8 MHz, measured at 3 meters, GFSK Modulation, 250 kbps data rate, Internal Antenna, PLS=15, MAC:0013500200A6FF39, Part Number: 174-0396 rev 07											
4945.6	36.21	296	100	V	33.147	4.52	27.75	46.127	74	-27.873	Peak
4945.6	36.31	286	121	H	33.147	4.52	27.75	46.227	74	-27.773	Peak
4945.6	30.25	296	100	V	33.147	4.52	27.75	40.167	54	-13.833	Ave
4945.6	31	286	121	H	33.147	4.52	27.75	40.917	54	-13.083	Ave
7418.4	35.37	40	100	V	37.486	5.62	27.51	50.966	74	-23.034	Peak
7418.4	35.08	303	100	H	37.486	5.62	27.51	50.676	74	-23.324	Peak
7418.4	28.33	40	100	V	37.486	5.62	27.51	43.926	54	-10.074	Ave
7418.4	26.37	303	100	H	37.486	5.62	27.51	41.966	54	-12.034	Ave

Company Name: Silver Spring Networks
Project Number:T1308302
Tester: Bo Li
Date: 2013-08-30 and 2013-09-04
Above 1G at (Chamber3)

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Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2400.8 MHz, measured at 3 meters, GFSK Modulation, 250 kbps data rate, External Antenna, PLS=15, MAC:0013500200A6FF39, Part Number: 174-0396 rev 07											
4801.6	43.63	78	100	V	33.027	4.56	27.7	53.517	74	-20.483	Peak
4801.6	40.75	307	100	H	33.027	4.56	27.7	50.637	74	-23.363	Peak
4801.6	41.21	78	100	V	33.027	4.56	27.7	51.097	54	-2.903	Ave
4801.6	36.97	307	100	H	33.027	4.56	27.7	46.857	54	-7.143	Ave
7202.4	38.14	97	115	V	37.633	5.49	27.58	53.683	74	-20.317	Peak
7202.4	37.24	52	109	H	37.633	5.49	27.58	52.783	74	-21.217	Peak
7202.4	34.3	97	115	V	37.633	5.49	27.58	49.843	54	-4.157	Ave
7202.4	31.32	52	109	H	37.633	5.49	27.58	46.863	54	-7.137	Ave
9603.2	34.46	348	100	V	38.998	6.54	27.06	52.938	74	-21.062	Peak
9603.2	33.11	233	100	H	38.998	6.54	27.06	51.588	74	-22.412	Peak
9603.2	26.75	348	100	V	38.998	6.54	27.06	45.228	54	-8.772	Ave
9603.2	22.93	233	100	H	38.998	6.54	27.06	41.408	54	-12.592	Ave
Middle channel 2440 MHz measured at 3 meters GFSK Modulation External Antenna, 250 kbps data rate, PLS=15, MAC:0013500200A6FF39 Part Number: 174-0396 REV 07											
4880	37.05	297	100	H	33.27	4.54	27.67	47.19	74	-26.81	Peak
4880	30.57	297	100	H	33.27	4.54	27.67	40.71	54	-13.29	Ave
4880	38.58	61	100	V	33.27	4.54	27.67	48.72	74	-25.28	Peak
4880	34.13	61	100	V	33.27	4.54	27.67	44.27	54	-9.73	Ave
7320	36.55	314	100	H	35.89	5.57	27.51	50.5	74	-23.5	Peak
7320	30.08	314	100	H	35.89	5.57	27.51	44.03	54	-9.97	Ave
7320	38.44	309	113	V	35.89	5.57	27.51	52.39	74	-21.61	Peak
7320	33.8	309	113	V	35.89	5.57	27.51	47.75	54	-6.25	Ave
12200	30	0	100	H	38.99	7.89	26.99	49.89	74	-24.11	Peak
12200	20	0	100	H	38.99	7.89	26.99	39.89	54	-14.11	Ave
12200	30	0	100	V	38.99	7.89	26.99	49.89	74	-24.11	Peak
12200	20	0	100	V	38.99	7.89	26.99	39.89	54	-14.11	Ave
High Channel 2472.8 MHz, measured at 3 meters, GFSK Modulation, 250 kbps data rate, External Antenna, PLS=15, MAC:0013500200A6FF39, Part Number: 174-0396 rev 07											
4945.6	36.38	77	100	V	33.147	4.52	27.75	46.297	74	-27.703	Peak
4945.6	34.9	105	137	H	33.147	4.52	27.75	44.817	74	-29.183	Peak
4945.6	30.03	77	100	V	33.147	4.52	27.75	39.947	54	-14.053	Ave
4945.6	26.1	105	137	H	33.147	4.52	27.75	36.017	54	-17.983	Ave
7418.4	39.15	91	100	V	37.486	5.62	27.51	54.746	74	-19.254	Peak
7418.4	37.23	84	100	H	37.486	5.62	27.51	52.826	74	-21.174	Peak
7418.4	34.09	91	100	V	37.486	5.62	27.51	49.686	54	-4.314	Ave
7418.4	31.64	84	100	H	37.486	5.62	27.51	47.236	54	-6.764	Ave

Radiated Emissions Below 1 GHZ

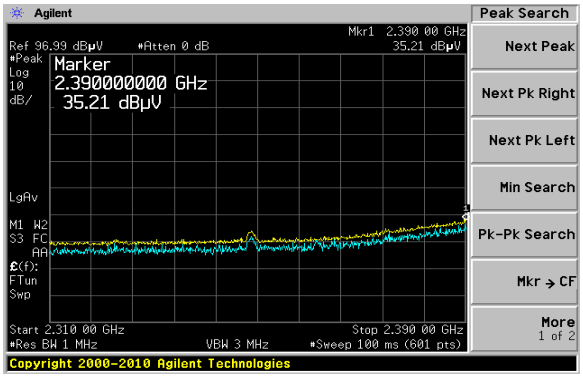
All TX emissions more than 20 dB below limits

Radiated Band edge Emissions – Internal antenna

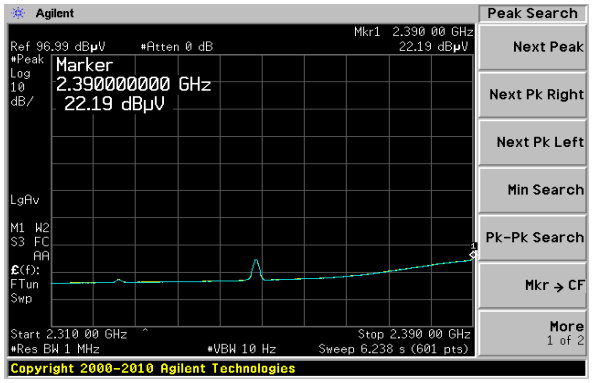
The worst-case band edge emissions are for internal antenna (highest antenna gain at 2.4 GHz) and 500 kbps (widest bandwidth).

Band edge radiated emissions plots are also provided. The data on the plots is uncorrected but correction factors are present in the tabulated band edge data.

Worst case, Low channel, Peak



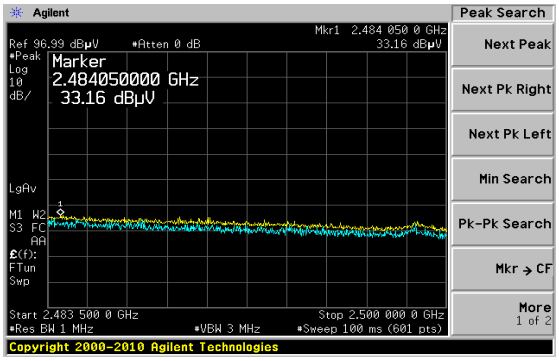
Worst case, Low channel, Ave



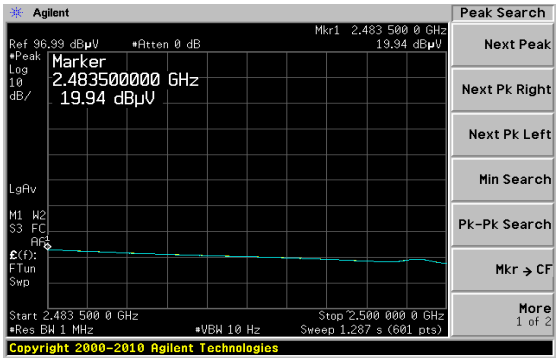
Frequency (MHz)	S.A. Reading (dBµV)	Test Antenna Height (cm)	Polarity (H/V)	Factor (dB/m)	Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC Limit (dBµV/m)	Margin (dB)
2385.87	30.41	100	V	28.132	3.12		61.662	74	-12.338
2390	35.21	100	H	28.132	3.12		66.462	74	-7.538
2348.8	17.16	100	V	28.132	3.12		48.412	54	-5.588
2390	22.19	100	H	28.132	3.12		53.442	54	-0.558

Radiated Band edge Emissions – Internal antenna

Worst case, High channel, Peak



Worst case, High channel, Ave.



Frequency (MHz)	S.A. Reading (dBµV)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC	
		Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)
2483.5	30.43	100	V	28.902	3.25		62.582	74	-11.418
2483.5	33.16	100	H	28.902	3.25		65.312	74	-8.688
2483.5	15.68	100	V	28.902	3.25		47.832	54	-6.168
2483.5	19.94	100	H	28.902	3.25		52.092	54	-1.908

20 dB Bandwidth

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to approximately 5% of the 20 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

No non-compliance noted:

500 kbps

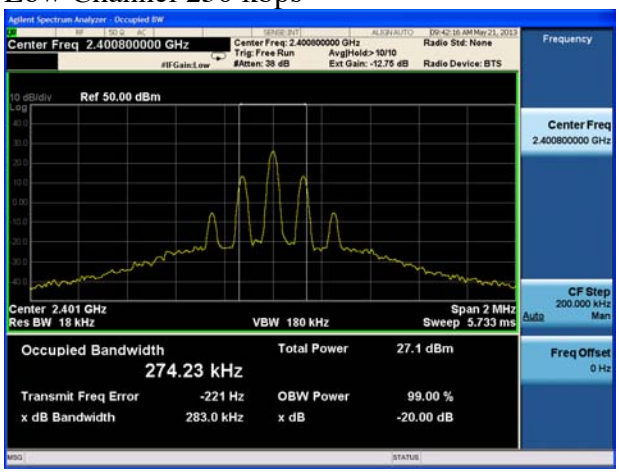
Channel	Frequency (MHz)	99% Bandwidth. kHz	20 dB Bandwidth, kHz
Low	2400.8	570.62	591.5
Middle	2440	572.11	592.9
High	2472.8	573.48	593.7

250 kbps

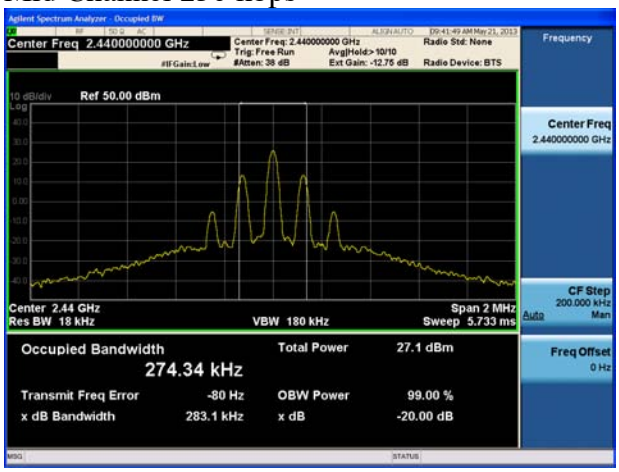
Channel	Frequency (MHz)	99% Bandwidth, kHz	20 dB Bandwidth, kHz
Low	2400.8	274.33	283
Middle	2440	274.34	283.1
High	2472.8	274.38	283

Occupied Bandwidth, 250 kbps setting

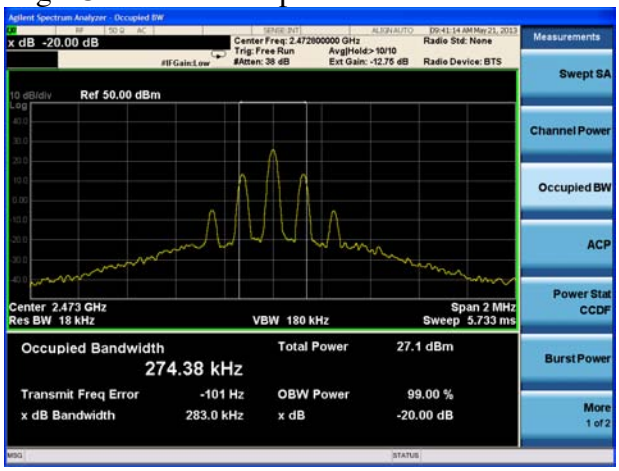
Low Channel 250 kbps



Mid Channel 250 kbps

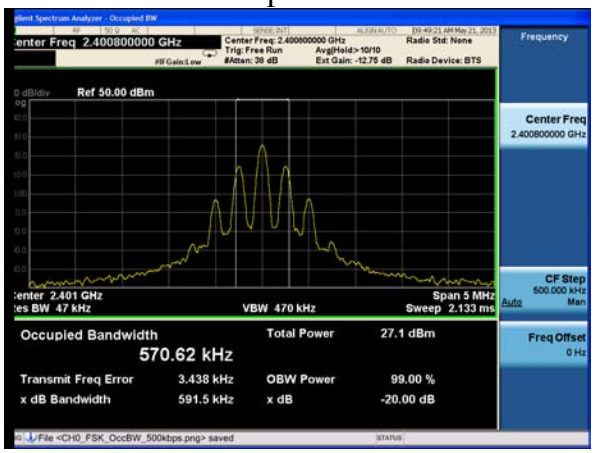


High Channel 250 kbps

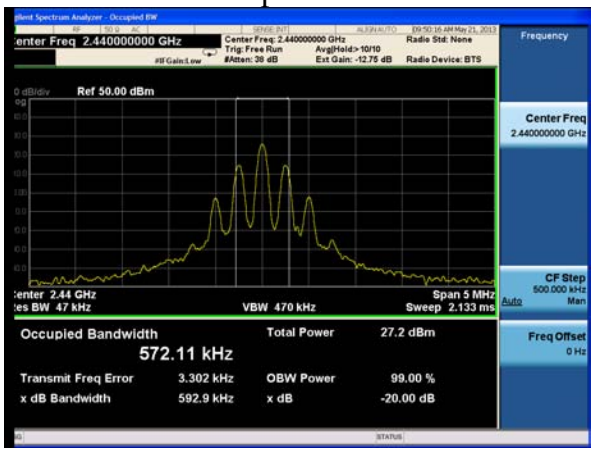


Occupied Bandwidth 500 kbps

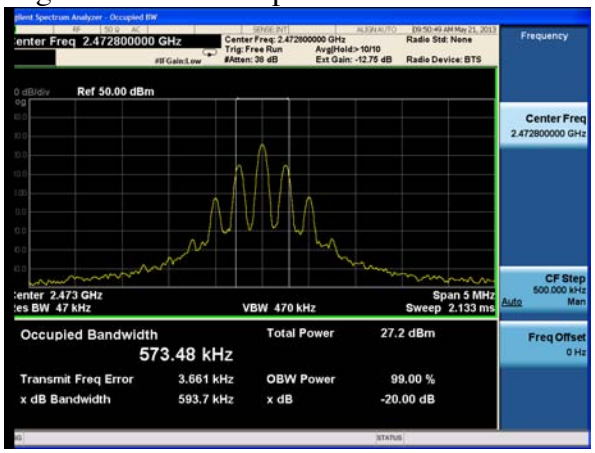
Low channel 500 kbps



Mid channel 500 kbps



High channel 500 kbps



HOPPING FREQUENCY SEPARATION

LIMIT

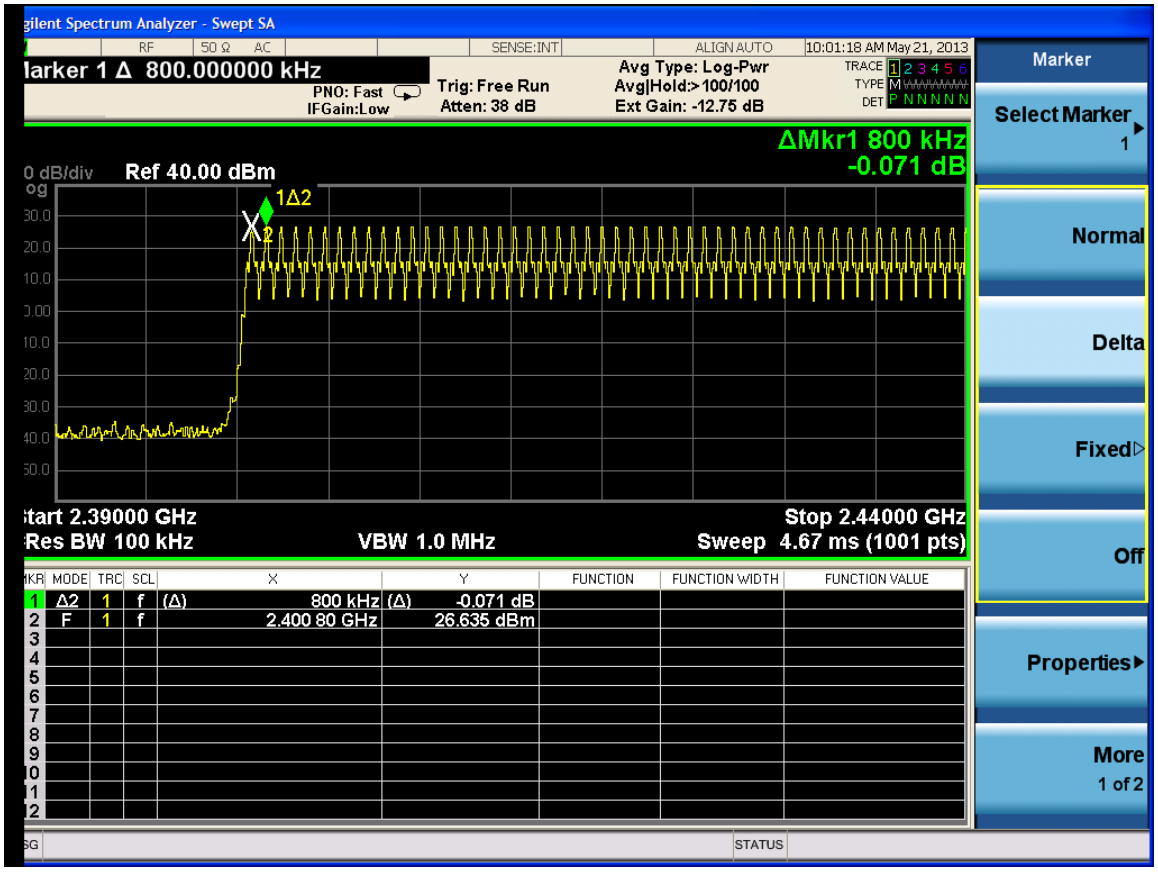
§15.247 (a) (1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 1 MHz. The sweep time is coupled.

RESULT

No non-compliance noted:
The separation is 800 KHz.



NUMBER OF HOPPING CHANNELS

LIMIT

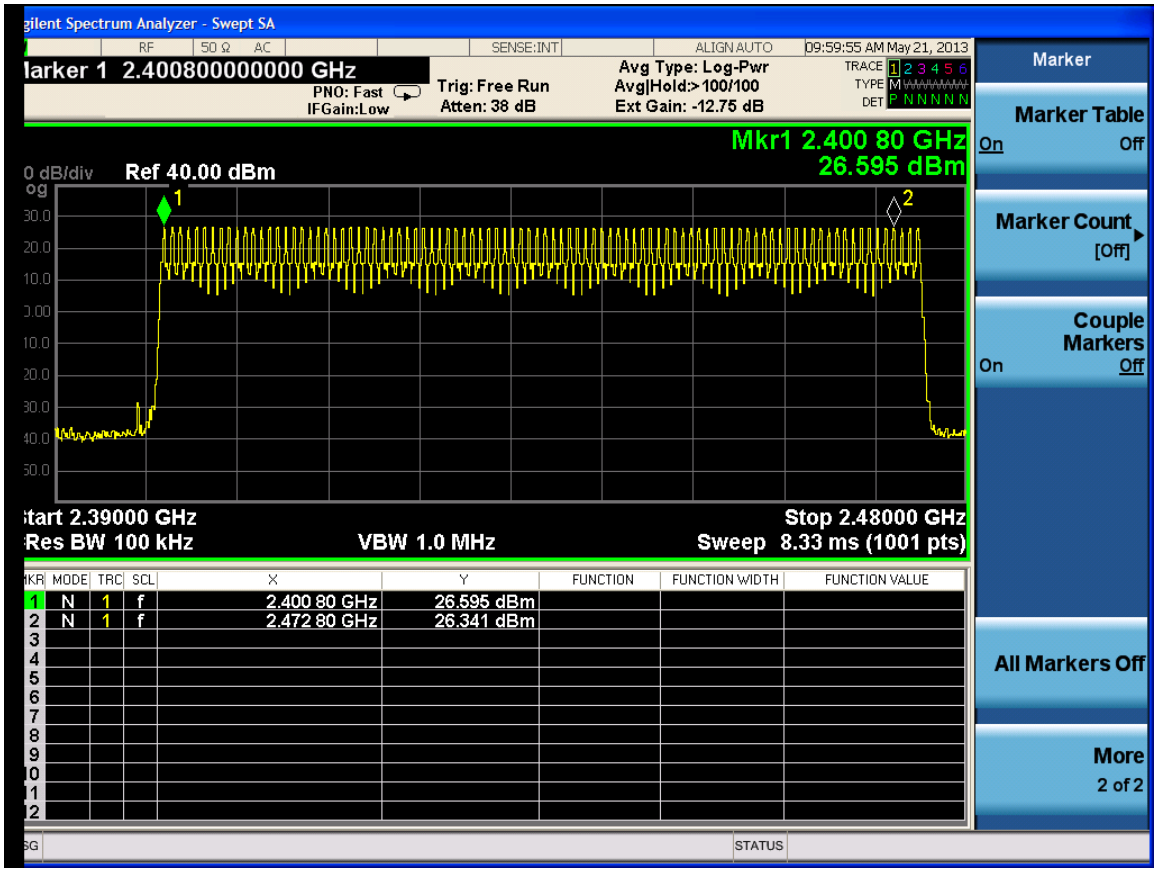
§15.247 (a) (1) (i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; 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.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to 3 % of the span. The analyzer is set to Max Hold.

RESULTS

No non-compliance noted:
91 Channels observed



AVERAGE TIME OF OCCUPANCY

LIMIT

§15.247 (a) (1) (iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

TEST PROCEDURE

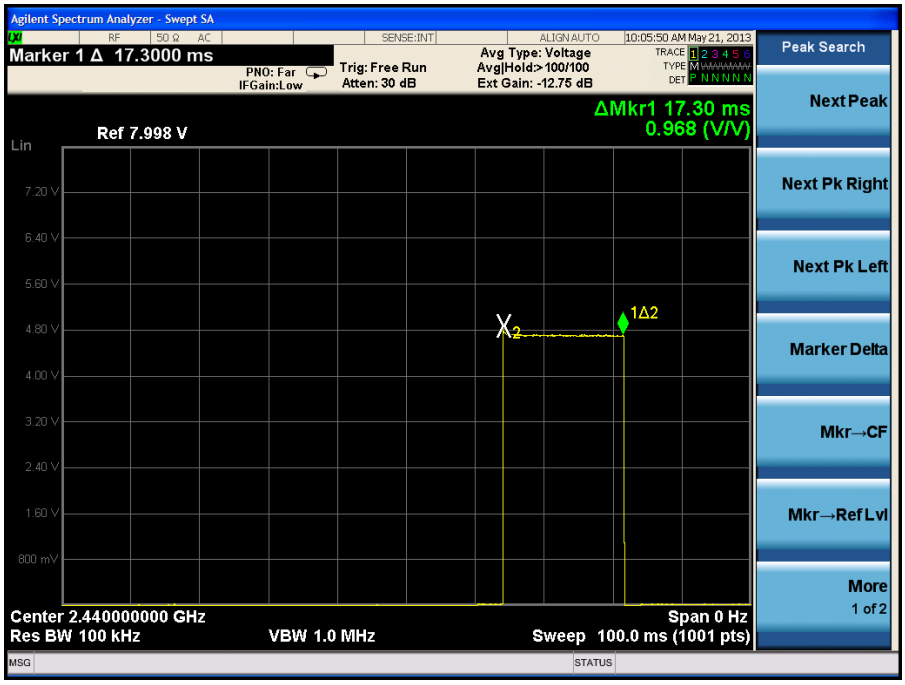
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 20 second scan, to enable resolution of each occurrence.

RESULTS

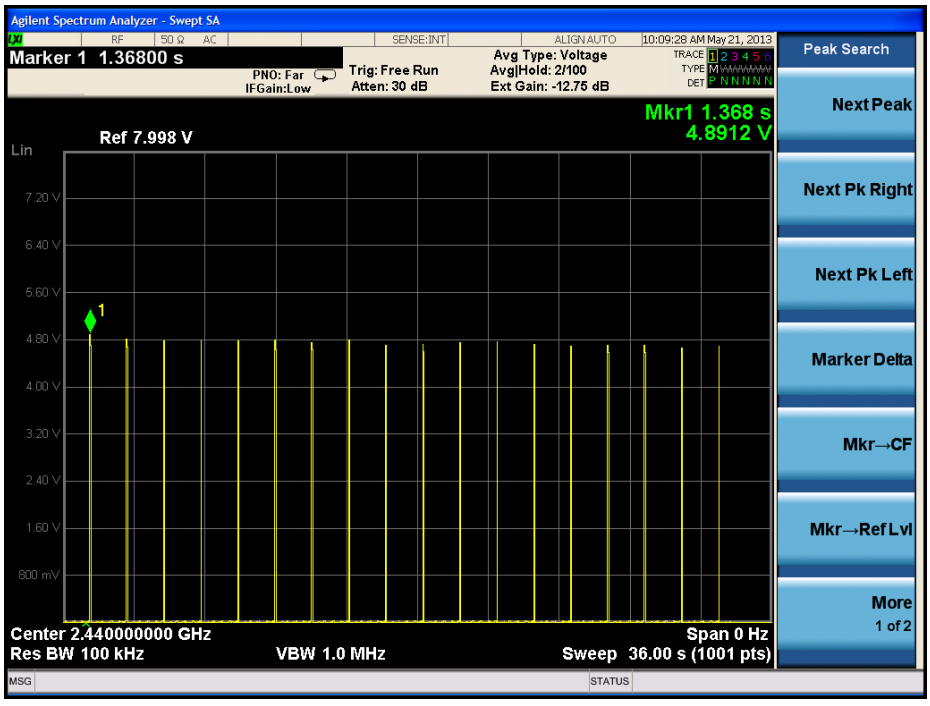
No non-compliance noted:

Channel Separation	Hop duration msec	Total hops/36 sec	Average time of occupancy msec	Limit in 36 sec, msec
800 kHz	17.3	18	311.4	400

Hop duration



NUMBER OF PULSES IN 36 SECOND OBSERVATION PERIOD



PEAK OUTPUT POWER

PEAK POWER LIMIT

§15.247 (b) The maximum peak output power of the intentional radiator shall not exceed the following:

§15.247 (b) (1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.
§15.247 (b) (4) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is 5.6 dBi, therefore the power limit is 30 dBm.

TEST PROCEDURE

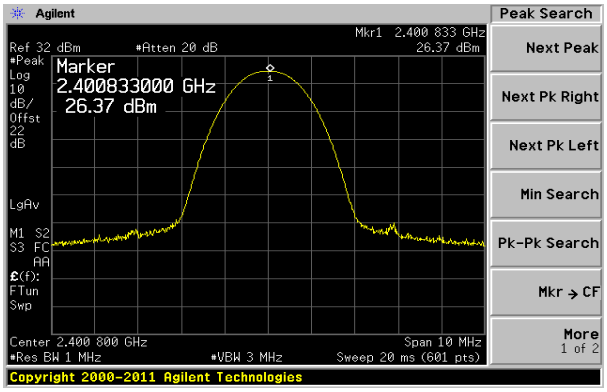
The transmitter output is connected to a spectrum analyzer and the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

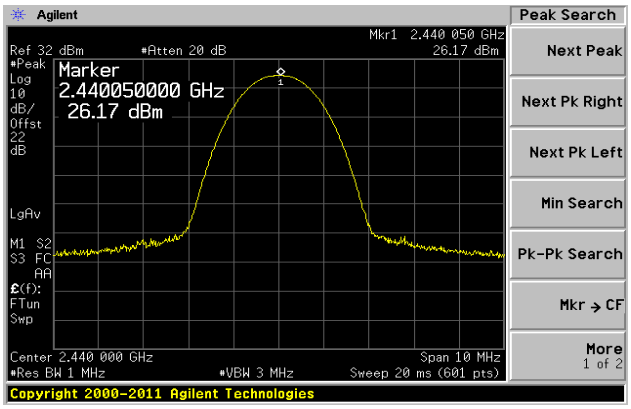
No non-compliance noted:

Channel	Frequency	P out, dBm	P out, watts
Low	2400.8	26.37	0.433
Mid	2440	26.17	0.414
High	2472.8	26.4	0.436

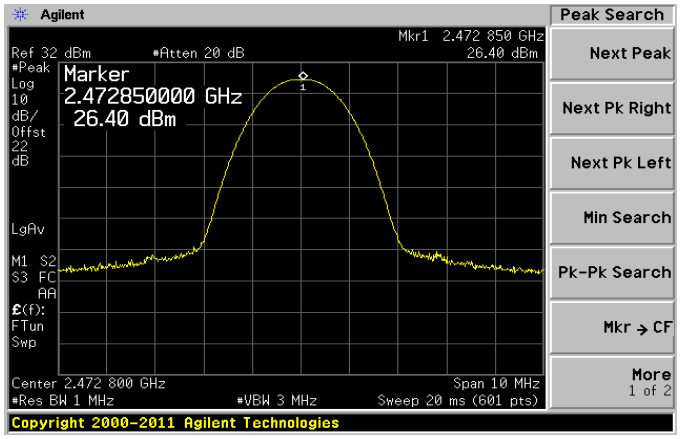
OUTPUT POWER LOW CHANNEL



OUTPUT POWER MID CHANNEL



OUTPUT POWER HIGH CHANNEL



MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

CALCULATIONS

Given

$E = \sqrt{(30 * P * G) / d}$

and

$S = E ^ 2 / 3770$

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of Power to mW and Distance to cm, using:

P (mW) = P (W) / 1000 and
d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$
$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)

yields

$d = 0.282 * 10 ^ ((P + G) / 20) / \sqrt{S}$ Equation (1)

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Equation (1) and the measured peak power is used to calculate the MPE distance.

LIMITS

From §1.1310 Table 1 (B), S = 1.0 mW/cm^2

RESULTS

No non-compliance noted:

Power Density Limit (mW/cm^2	Output power (dBm)	Antenna gain (dBi)	s, mW/cm^2 at 20cm	MPE Distance cm
1.0	26.4	5.6	0.32	11.2

Maximum MPE calculated for internal antenna (maximum eirp from EUT)
NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.247 (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. 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)).

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

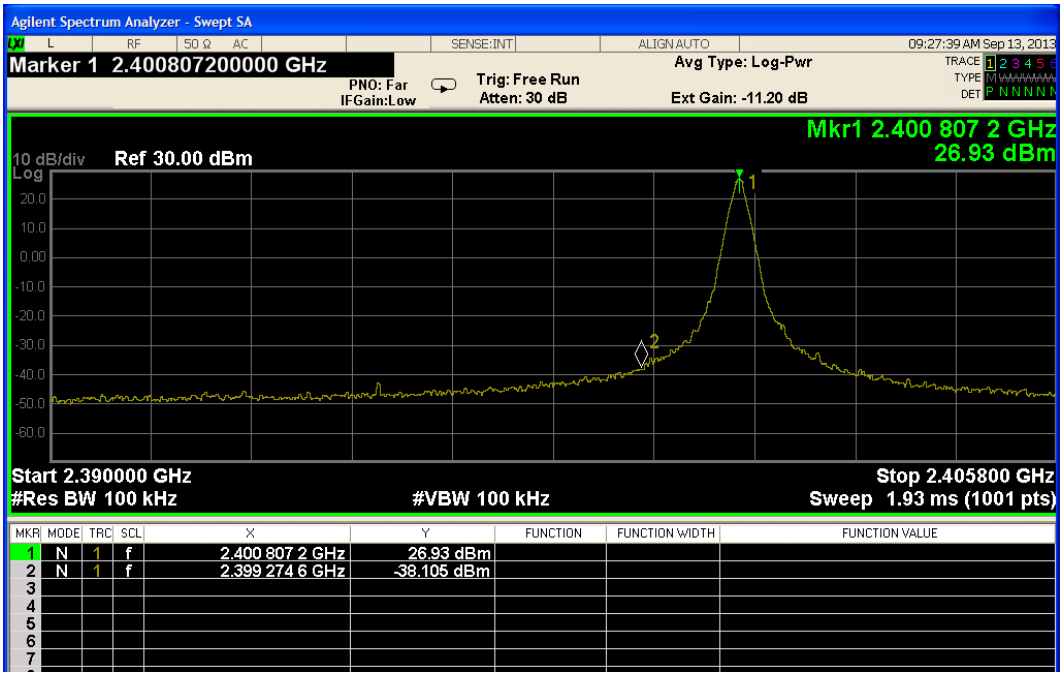
The spectrum from 30 MHz to 10 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

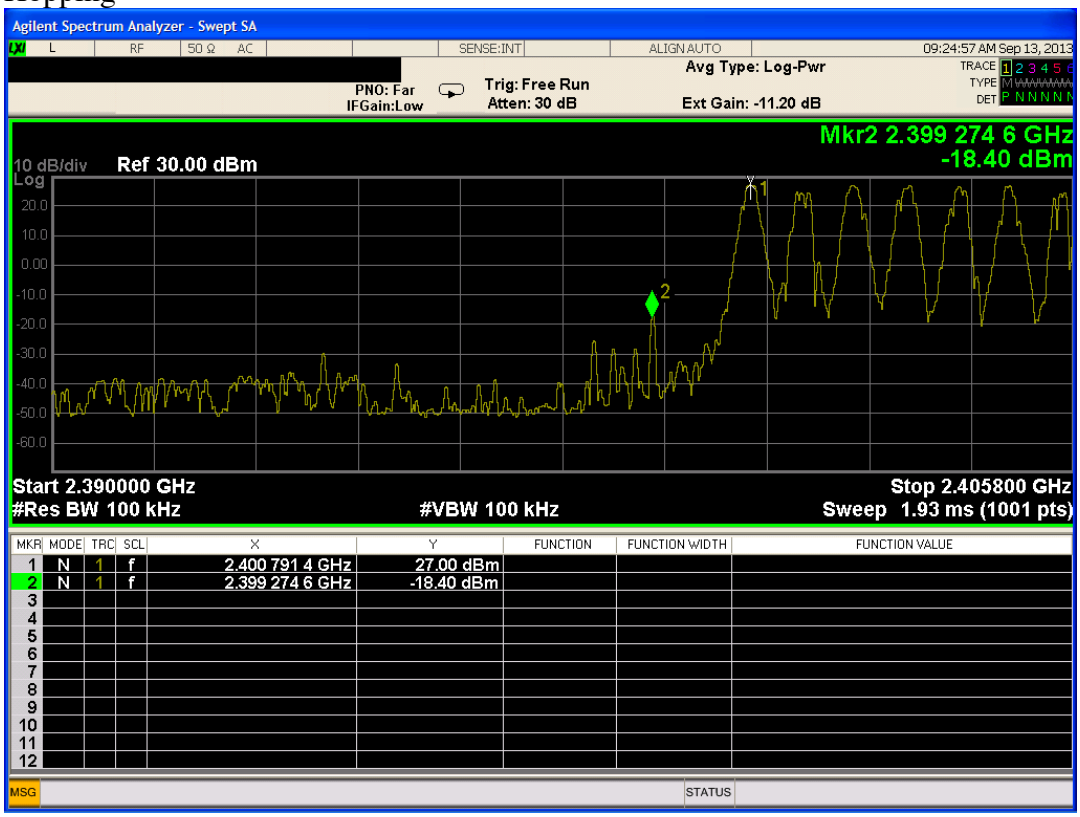
Band edge hopping and non-hopping spurious emissions antenna port conducted emissions were performed at Silver Spring Networks. The results are found in the spectrum analyzer plots below.

The rest of the required antenna port conducted spurious emissions was performed on the NIC414 by BACL for all three operating modes. Data is presented in a separate report dated 2013-07-11.

Low Channel, 2400.8 MHz
Cont. Tx

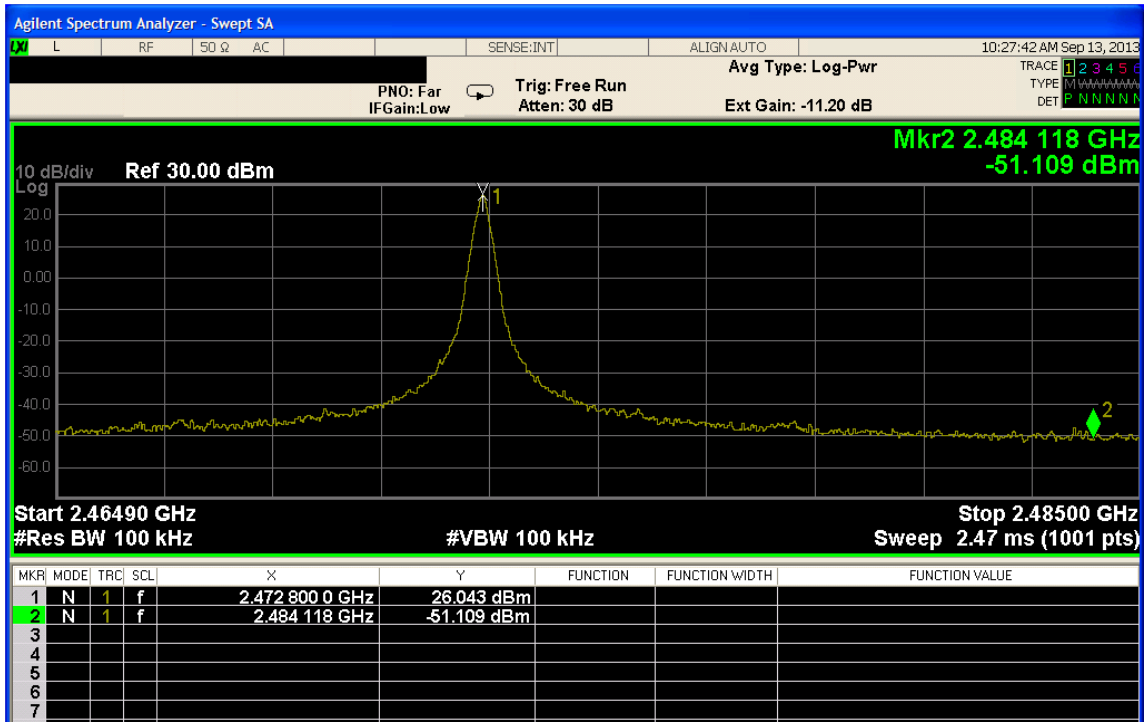


Hopping

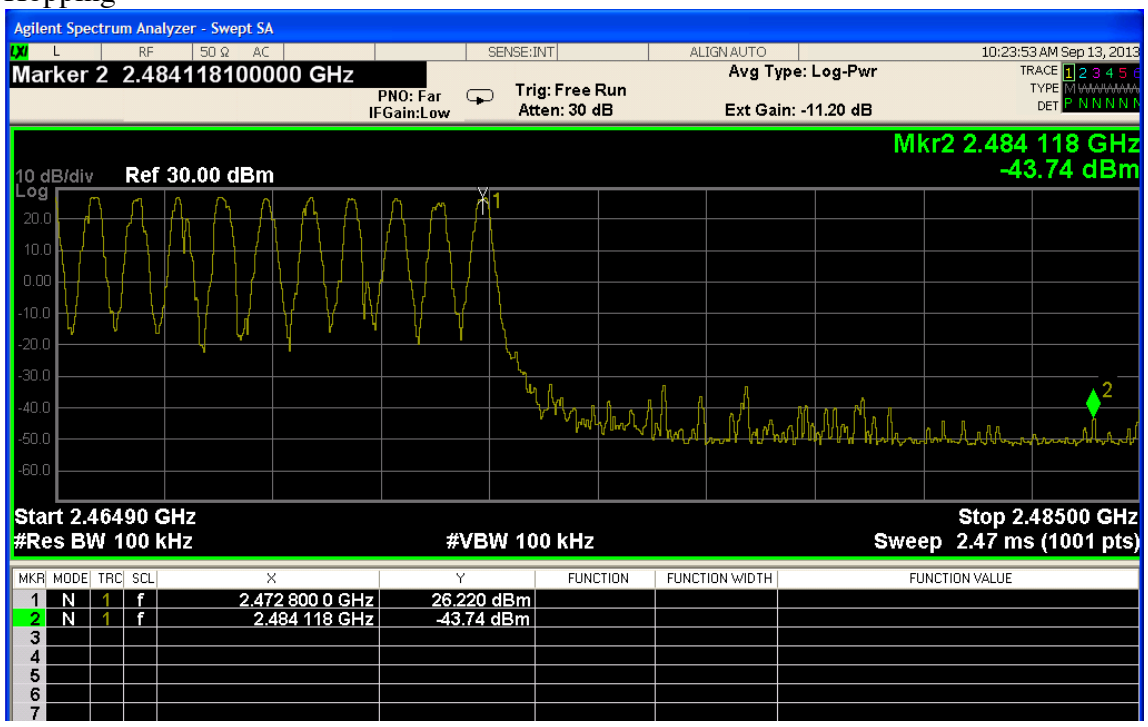


High Channel, 2472.8 MHz

Cont. Tx



Hopping



END OF REPORT

Report Revision History

Revision No.	Revision Description	Pages Revised	Revised by	Date
-	Original		T. Cokenias	08/15/2013
1	Band edge re-test with correct SW settings Low and High power output re-test with correct settings Add hopping and non-hopping band edge spurious emissions data	9,10, 18,19,25	T. Cokenias	9/15/2013

Model Number Difference Description

Descriptions of model numbers sold using this identifier are listed below. In the United States the FCC does not track model numbers for certification purposes, however, there are other regulatory domains that accept FCC certification reports and that do track model numbers, so the model number descriptions are listed here for reference.

NIC 411-0301:	900 MHz FHSS NAN1, 2.4 GHz HAN, INT ANT
NIC 411-0302:	900 MHz FHSS NAN1, 2.4 GHz HAN, EXT ANT
NIC 411-0303:	900 MHz FHSS NAN1, 2.4 GHz HAN, INT/EXT ANT
NIC 411-0701:	900 MHz FHSS NAN1, 2.4 GHz HAN, 2.4 GHz NAN2, INT ANT
NIC 411-0702:	900 MHz FHSS NAN1, 2.4 GHz HAN, 2.4 GHz NAN2, EXT ANT
NIC 411-0703:	900 MHz FHSS NAN1, 2.4 GHz HAN, 2.4 GHz NAN2, INT/EXT ANT

NAN1:	900 MHz FHSS
NAN2:	2.4 GHz FHSS
HAN:	2.4 GHz DSSS (Zigbee)