

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

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 board incorporates a 900 MHz frequency hopping mesh network radio and a 2.4GHz 802.15.4 Zigbee Home Area Network (HAN) radio. The internal antenna gain has changed, and the front end has been replaced with a new RFMD front end module (FEM).

III. TEST DATES AND TEST LOCATION

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

2.4 GHz radiated band edge emissions:
Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538

Radiated emissions:
BACL Laboratories
1274 Anvilwood Ave.
Sunnyvale, CA 94089

Antenna port conducted tests were performed at Silver Spring Networks.



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

2 August 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 3.6 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

Compliance Certification Services:

Test Equipment List					
Description	Manufacturer	Model	Asset	Cal Date	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00986	4/1/2013	4/1/2014
Antenna, Horn, 18 GHz	ETS	3117	C01022	2/21/2013	2/21/2014
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	10/22/2012	10/22/2013

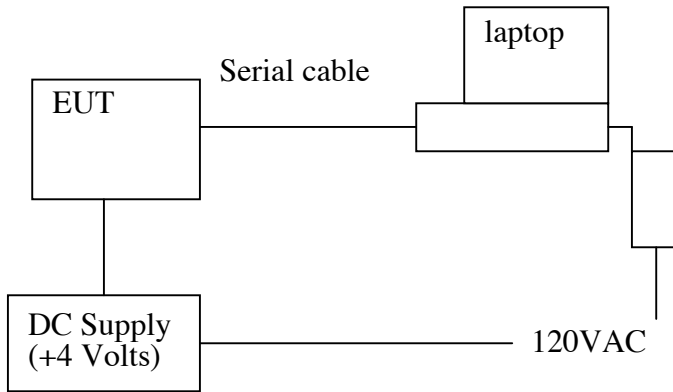
BACL

Manufacturer	Description	Model No.	Serial No.	Calibration Due
Agilent	Spectrum Analyzer	E4440A	MY44303352	2013-05-10
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2013-06-29
EMCO	Horn antenna	3115	9511-4627	2013-10-03
ARA	Horn antenna	ARH-4223-02	10555-02	2013-06-14
Hewlett Packard	Pre amplifier	8447D	2944A06639	2013-06-09
Wisewave	Pre amplifier	ALN-22093530-01	12263-01	2013-06-13
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2013-05-09

Silver Spring Networks

Equipment	Mfr	Model	Serial No.	Cal Due
Spectrum analyzer	Agilent	E4405B	MY45113391	01/23/14
Spectrum analyzer	Agilent	N9030A	MY48030147	01/23/14

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 HAN Radio Emissions Test Results

TEST RESULTS

Radiated Test Set-up, 30-25 GHz

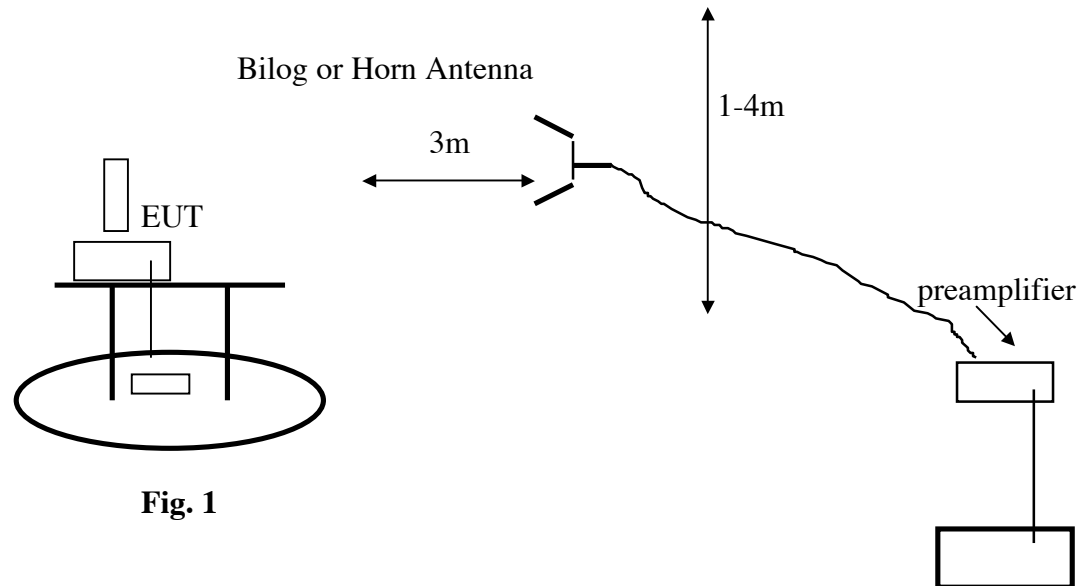


Fig. 1

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 10th 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 are presented. 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

2.4 GHz HAN Radiated Spurious

Internal antenna



Company Name: Silver Spring Networks
 Product Type: Board
 Project Number: T1304111
 Tester: Wei Sun
 Date: 2013-04-11

Horn antenna: EMCO 3115
 Amplifier: mini circuit 570400946, HP 8447D SN:2944a06039
 Spectrum Analyzer: MY44303352
 cable: SPS-2303-3840-SPS 32 feet, chamber 3 below 1 Ghz cable
 Bilog Antenna: Sunoi Jb4 a020106-3

FCC 15 C in 5 M Chamber 2 at 3 meters distance

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC 15.247		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low channel 2405 MHz measured at 3 meters DSSS Modulation Internal Antenna. MAC: 0013500200A6FF39 Part Number: 174-0396 REV 07											
4810	34.31	158	100	H	33.1	4.56	27.78	44.19	74	-29.81	Peak
4810	21.05	158	100	H	33.1	4.56	27.78	30.93	54	-23.07	Ave
4810	36	255	100	V	33.1	4.56	27.78	45.88	74	-28.12	Peak
4810	23.24	255	100	V	33.1	4.56	27.78	33.12	54	-20.88	Ave
7215	30	0	100	H	35.89	5.49	27.59	43.79			Peak
7215	20	0	100	H	35.89	5.49	27.59	33.79			Ave
7215	30	0	100	V	35.89	5.49	27.59	43.79			Peak
7215	20	0	100	V	35.89	5.49	27.59	33.79			Ave
9620	30	0	100	H	37.95	6.54	27.02	47.47			Peak
9620	20	0	100	H	37.95	6.54	27.02	37.47			Ave
9620	30	0	100	V	37.95	6.54	27.02	47.47			Peak
9620	20	0	100	V	37.95	6.54	27.02	37.47			Ave
12025	30	0	100	H	39.29	7.78	26.99	50.08	74	-23.92	Peak
12025	20	0	100	H	39.29	7.78	26.99	40.08	54	-13.92	Ave
12025	30	0	100	V	39.29	7.78	26.99	50.08	74	-23.92	Peak
12025	20	0	100	V	39.29	7.78	26.99	40.08	54	-13.92	Ave
14430	30	0	100	H	42.56	8.02	25.99	54.59			Peak
14430	20	0	100	H	42.56	8.02	25.99	44.59			Ave
14430	30	0	100	V	42.56	8.02	25.99	54.59			Peak
14430	20	0	100	V	42.56	8.02	25.99	44.59			Ave
16835	30	0	100	H	40.46	8.64	26.11	52.99			Peak
16835	20	0	100	H	40.46	8.64	26.11	42.99			Ave
16835	30	0	100	V	40.46	8.64	26.11	52.99			Peak
16835	20	0	100	V	40.46	8.64	26.11	42.99			Ave
Middle channel 2440 MHz measured at 3 meters DSSS Modulation Internal Antenna. MAC: 0013500200A6FF39 Part Number: 174-0396 REV 07											
4880	34.38	163	100	H	33.27	4.54	27.67	44.52	74	-29.48	Peak
4880	21.66	163	100	H	33.27	4.54	27.67	31.8	54	-22.2	Ave
4880	36.55	294	100	V	33.27	4.54	27.67	46.69	74	-27.31	Peak
4880	24.5	294	100	V	33.27	4.54	27.67	34.64	54	-19.36	Ave
7320	30	0	100	H	35.89	5.57	27.51	43.95	74	-30.05	Peak
7320	20	0	100	H	35.89	5.57	27.51	33.95	54	-20.05	Ave
7320	30	0	100	V	35.89	5.57	27.51	43.95	74	-30.05	Peak
7320	20	0	100	V	35.89	5.57	27.51	33.95	54	-20.05	Ave
9760	30	0	100	H	38.25	6.62	26.98	47.89			Peak
9760	20	0	100	H	38.25	6.62	26.98	37.89			Ave
9760	30	0	100	V	38.25	6.62	26.98	47.89			Peak
9760	20	0	100	V	38.25	6.62	26.98	37.89			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
14640	30	0	100	H	42.73	8.08	25.93	54.88			Peak
14640	20	0	100	H	42.73	8.08	25.93	44.88			Ave
14640	30	0	100	V	42.73	8.08	25.93	54.88			Peak
14640	20	0	100	V	42.73	8.08	25.93	44.88			Ave
17080	30	0	100	H	41.89	8.62	25.98	54.53			Peak
17080	20	0	100	H	41.89	8.62	25.98	44.53			Ave
17080	30	0	100	V	41.89	8.62	25.98	54.53			Peak
17080	20	0	100	V	41.89	8.62	25.98	44.53			Ave
High channel 2480 MHz measured at 3 meters DSSS Modulation Internal Antenna. MAC: 0013500200A6FF39 Part Number: 174-0396 REV 07											
9920	20	0	100	H	38.46	6.67	27.01	38.12			Ave
9920	30	0	100	V	38.46	6.67	27.01	48.12			Peak
9920	20	0	100	V	38.46	6.67	27.01	38.12			Ave
12400	30	0	100	H	38.79	8.02	26.92	49.89	74	-24.11	Peak
12400	20	0	100	H	38.79	8.02	26.92	39.89	54	-14.11	Ave
12400	30	0	100	V	38.79	8.02	26.92	49.89	74	-24.11	Peak
12400	20	0	100	V	38.79	8.02	26.92	39.89	54	-14.11	Ave
14880	30	0	100	H	41.59	8.37	26.06	53.9			Peak
14880	20	0	100	H	41.59	8.37	26.06	43.9			Ave
14880	30	0	100	V	41.59	8.37	26.06	53.9			Peak
14880	20	0	100	V	41.59	8.37	26.06	43.9			Ave
17360	30	0	100	H	45.3	8.66	25.86	58.1			Peak
17360	20	0	100	H	45.3	8.66	25.86	48.1			Ave
17360	30	0	100	V	45.3	8.66	25.86	58.1			Peak
17360	20	0	100	V	45.3	8.66	25.86	48.1			Ave



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 Product Type: Board
 Project Number:T1304111
 Tester: Wei Sun
 Date: 2013-04-11

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 Amplifier:mini circuit 570400946, HP 8447D SN:2944a06039
 Spectrum Analyzer: MY44303352
 cable: SPS-2303-3840-SPS 32 feet, chamber 3 below 1 Ghz cable
 Bilog Antenna: Sunoi Jb4 a020106-3

FCC 15 C in 5 M Chamber 2 at 3 meters distance

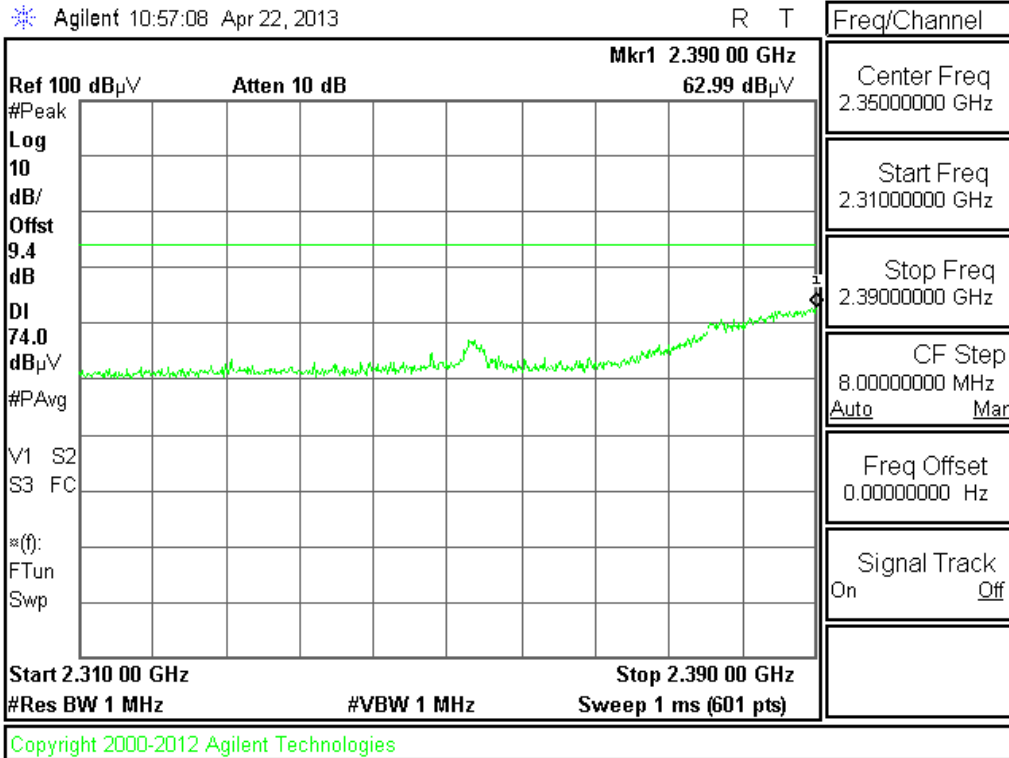
Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC 15.247		Comments	Power setting
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)		
Low channel 2405 MHz measured at 3 meters DSSS Modulation Exernal Antenna. MAC: 0013500200A6FF39 Part Number: 174-0396 REV 07												
4810	36.64	256	100	H	33.1	4.56	27.78	46.52	74	-27.48	Peak	112=12
4810	24.38	256	100	H	33.1	4.56	27.78	34.26	54	-19.74	Ave	112=12
4810	36.8	318	100	V	33.1	4.56	27.78	46.68	74	-27.32	Peak	112=12
4810	24.05	318	100	V	33.1	4.56	27.78	33.93	54	-20.07	Ave	112=12
12025	30	0	100	H	39.29	7.78	26.99	50.08	74	-23.92	Peak	112=12
12025	20	0	100	H	39.29	7.78	26.99	40.08	54	-13.92	Ave	112=12
12025	30	0	100	V	39.29	7.78	26.99	50.08	74	-23.92	Peak	112=12
12025	20	0	100	V	39.29	7.78	26.99	40.08	54	-13.92	Ave	112=12

Middle channel 2440 MHz measured at 3 meters GFSK Modulation Exernal Antenna. 250 kbps data rate 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	112=15
4880	30.57	297	100	H	33.27	4.54	27.67	40.71	54	-13.29	Ave	112=15
4880	38.58	61	100	V	33.27	4.54	27.67	48.72	74	-25.28	Peak	112=15
4880	34.13	61	100	V	33.27	4.54	27.67	44.27	54	-9.73	Ave	112=15
7320	36.55	314	100	H	35.89	5.57	27.51	50.5	74	-23.5	Peak	112=15
7320	30.08	314	100	H	35.89	5.57	27.51	44.03	54	-9.97	Ave	112=15
7320	38.44	309	113	V	35.89	5.57	27.51	52.39	74	-21.61	Peak	112=15
7320	33.8	309	113	V	35.89	5.57	27.51	47.75	54	-6.25	Ave	112=15
12200	30	0	100	H	38.99	7.89	26.99	49.89	74	-24.11	Peak	112=15
12200	20	0	100	H	38.99	7.89	26.99	39.89	54	-14.11	Ave	112=15
12200	30	0	100	V	38.99	7.89	26.99	49.89	74	-24.11	Peak	112=15
12200	20	0	100	V	38.99	7.89	26.99	39.89	54	-14.11	Ave	112=15

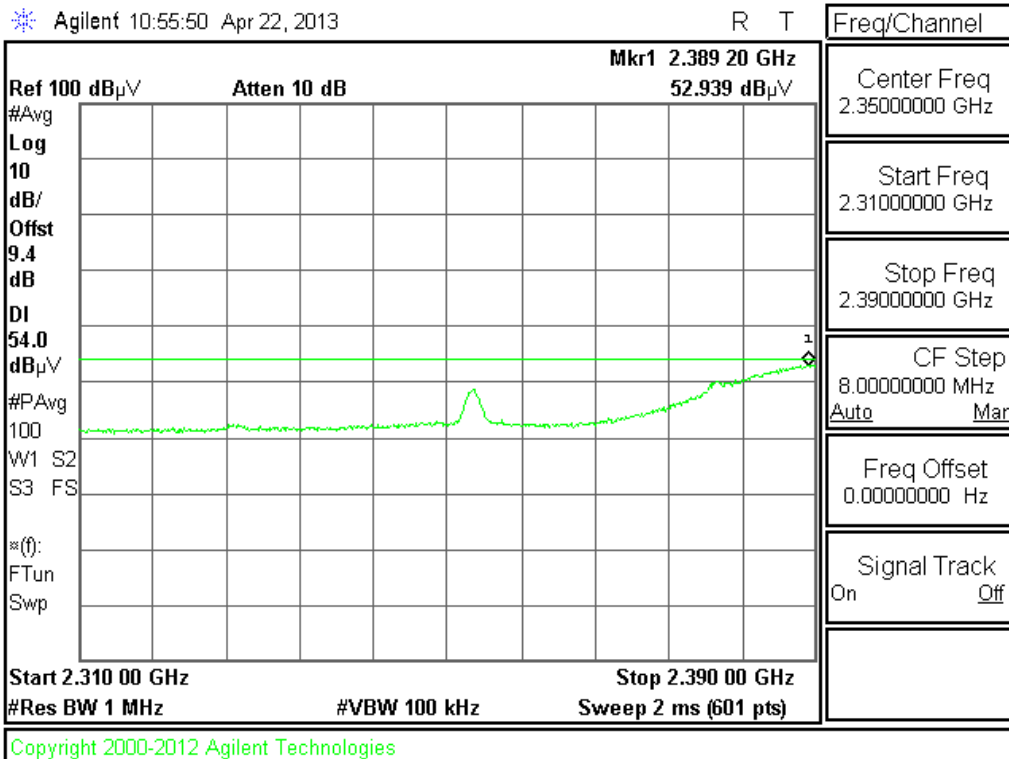
High channel 2480 MHz measured at 3 meters DSSS Modulation Exernal Antenna. MAC: 0013500200A6FF39 Part Number: 174-0396 REV 07												
4960	30	0	100	H	33.51	4.52	27.7	40.33	74	-33.67	Peak	112=3
4960	20	0	100	H	33.51	4.52	27.7	30.33	54	-23.67	Ave	112=3
4960	30	0	100	V	33.51	4.52	27.7	40.33	74	-33.67	Peak	112=3
4960	20	0	100	V	33.51	4.52	27.7	30.33	54	-23.67	Ave	112=3
12400	30	0	100	H	38.79	7.97	26.92	49.84	74	-24.16	Peak	112=3
12400	20	0	100	H	38.79	7.97	26.92	39.84	54	-14.16	Ave	112=3
12400	30	0	100	V	38.79	7.97	26.92	49.84	74	-24.16	Peak	112=3
12400	20	0	100	V	38.79	7.97	26.92	39.84	54	-14.16	Ave	112=3

Radiated Band edge Emissions – Internal antenna

Worst case, Low channel, Peak

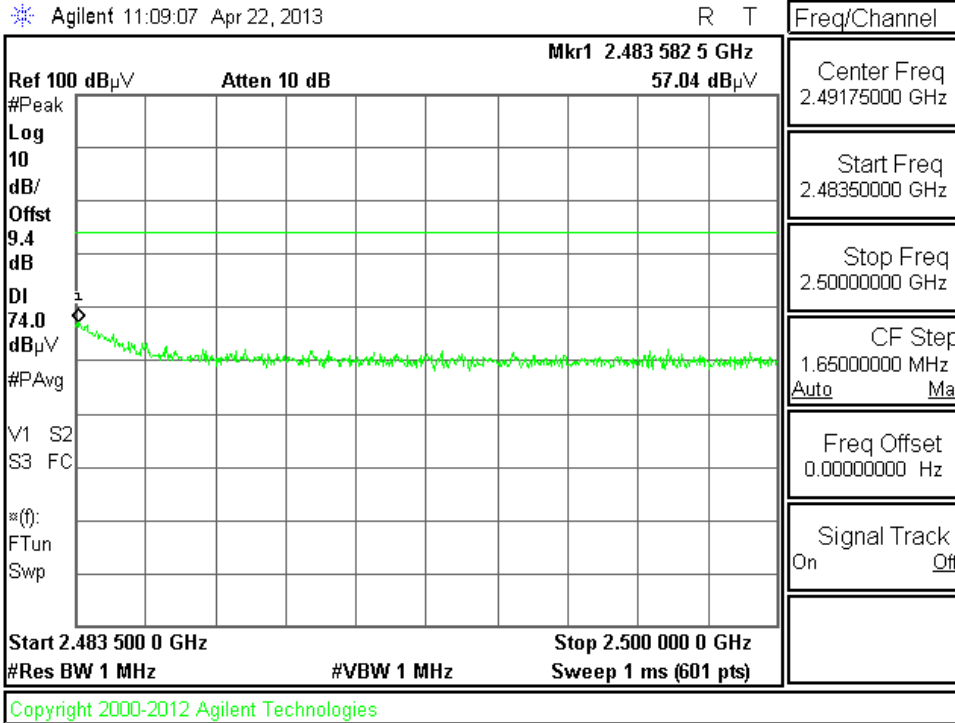


Worst case, Low channel, Ave

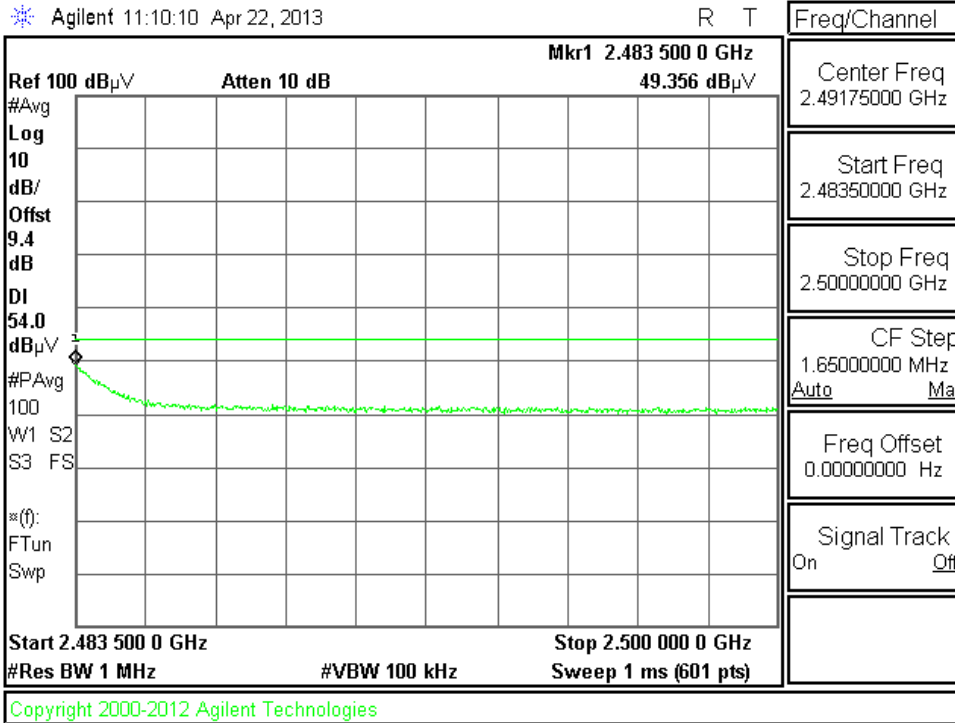


Radiated Band edge Emissions – Internal antenna

Worst case, High channel, Peak

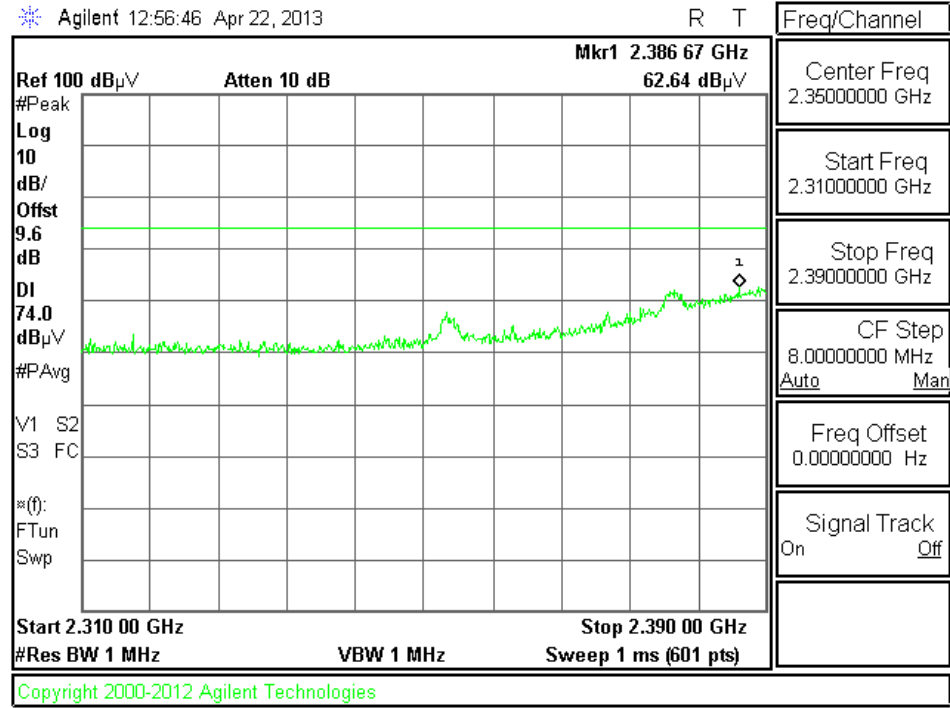


Worst case, High channel, Ave

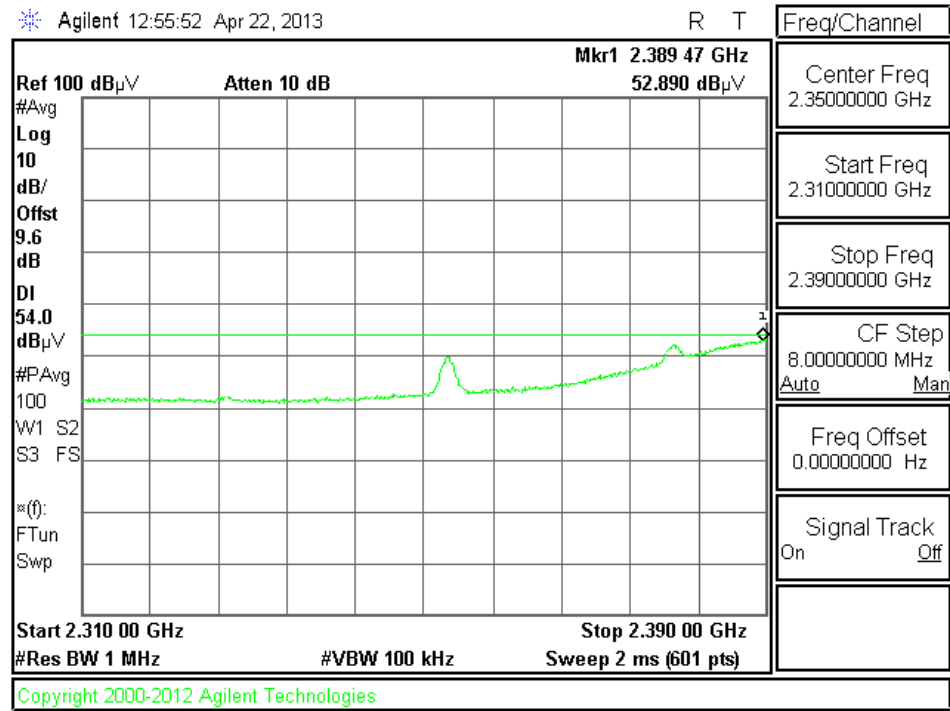


Radiated Band edge Emissions – External antenna

Worst case, Low channel, Peak

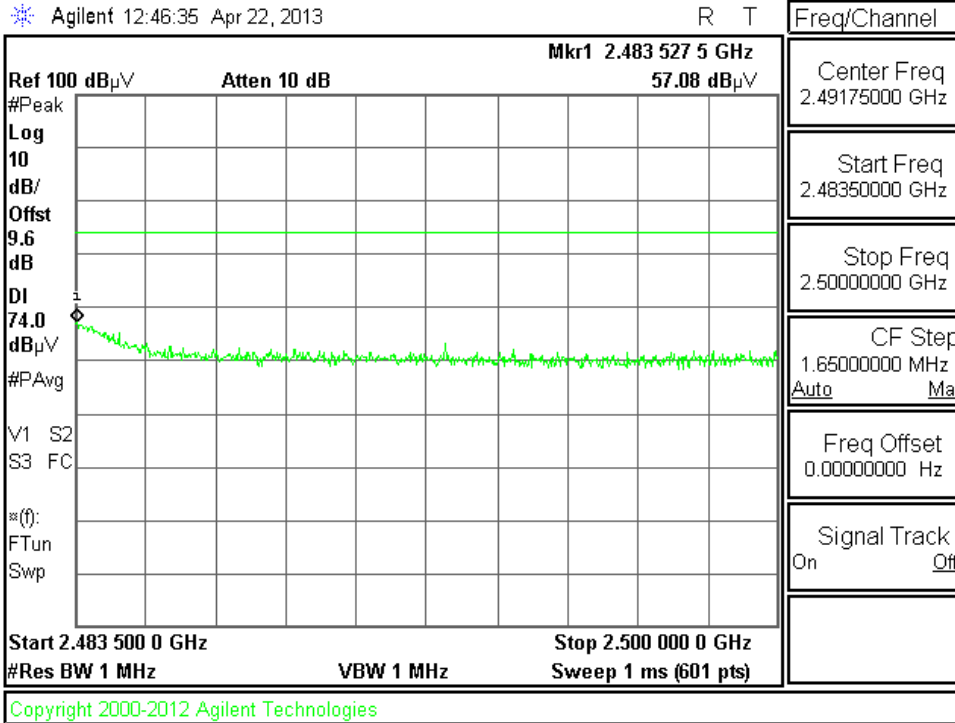


Worst case, Low channel, Ave

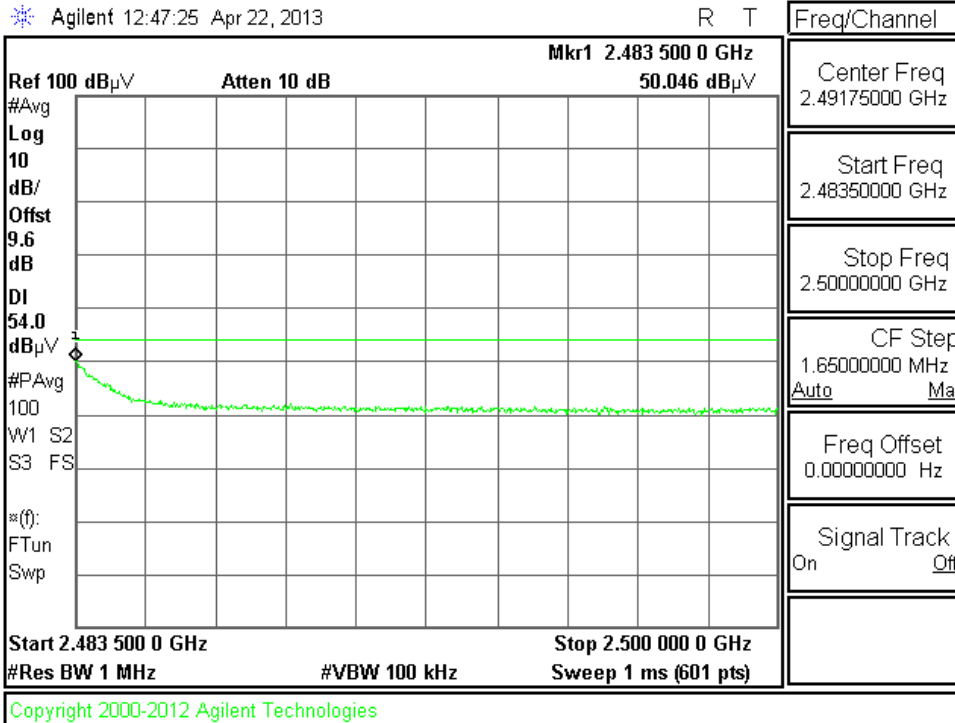


Radiated Band edge Emissions – External antenna

Worst case, High channel, Peak



Worst case, High channel, Ave



Silver Spring Networks
FCC ID: OWS-NIC714
IC: 5975A-NIC714

Report No: 13PRO009 Rev 1

Model No.: NIC414

Radiated Emissions 30-1000 MHz

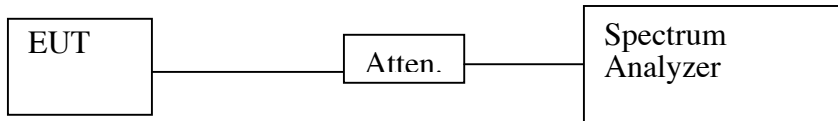
Internal antenna and External antenna

All transmitter emissions were at least 20 dB below limits

RF Power Output

Test Requirement: FCC: 15.247(b)
IC: RSS-210 Sec. 6.2.2(o)(iv)

Test Setup



Test Procedures

1. The EUT was configured on a test bench. RBW was set to a value higher than the 2.7 MHz 99% band width: RBW=3 MHz, VBW=5 MHz
2. The spectrum analyzer detector was set to PEAK and the highest value was recorded using the analyzer PEAK SEARCH function.

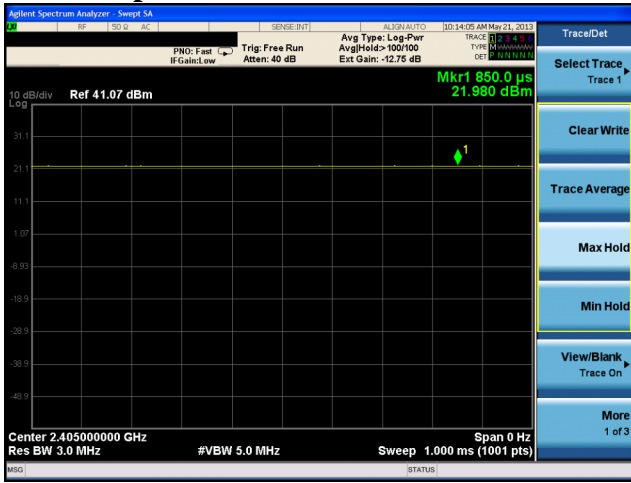
Test Results

Refer to spectrum analyzer graphs. Reference level offset corrects for external attenuation and cable loss.

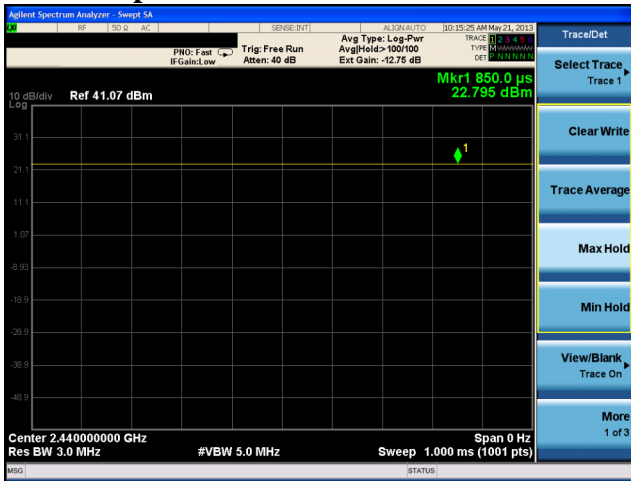
Channel	Frequency, MHz	Output Power, dBm
Low	2405	21.98
Mid	2440	22.8
High-1	2475	22.932
High	2480	2.56

Note: High channel power is limited by restricted band emissions requirement at 2483.5-2500 MHz.

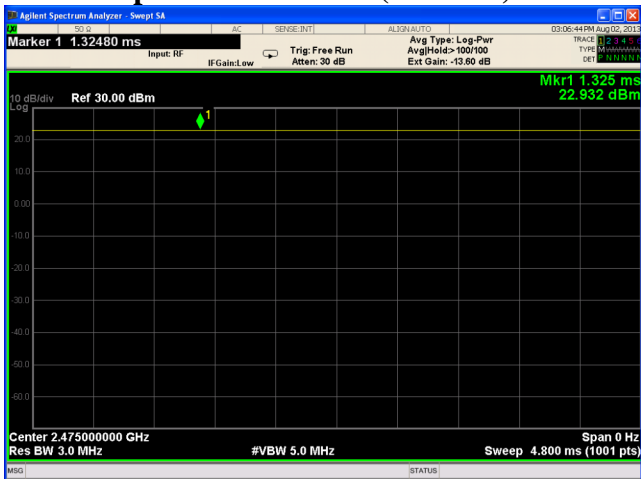
Peak Output Power LOW Channel



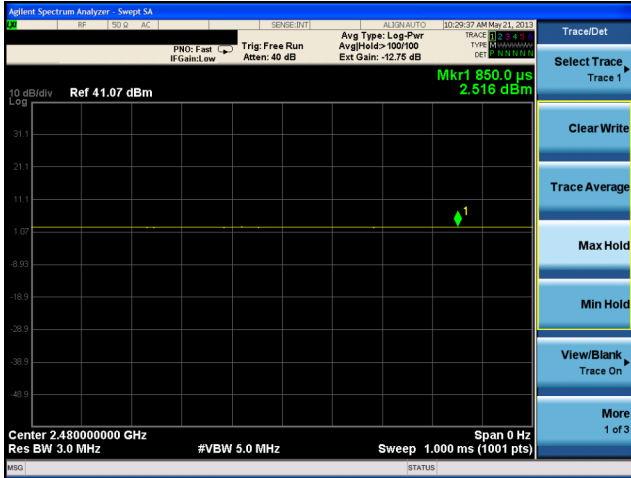
Peak Output Power MID Channel



Peak Output Power CH 25 (HIGH-1)



Peak Output Power CH26 (HIGH Channel)

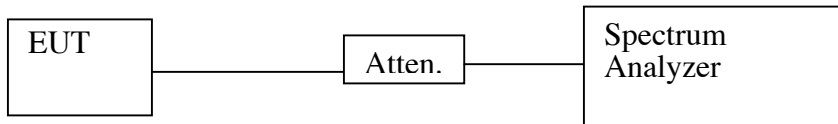


Spurious Emissions, Conducted

Test Requirement: FCC: 15.247(d)

IC: RSS-210 Sec. 6.2.2(o)(e1)

Test Setup



Test Procedure

1. The EUT was configured on a test bench. The cable was connected between the EUT antenna port and the spectrum analyzer input port.

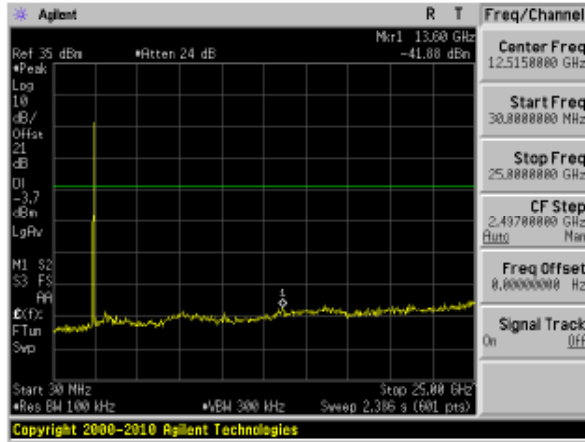
Spectrum analyzer RES BW was set to 100 kHz. While the transmitter broadcast a steady stream of digital data, the analyzer MAX HOLD function was used to capture the envelope of the transmission.

Readings were taken out to 10fo.

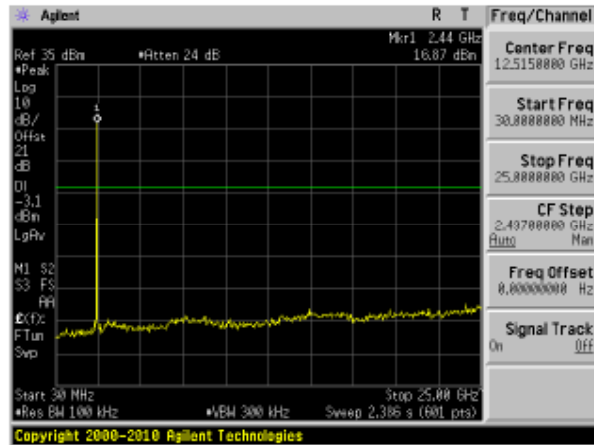
Test Results

Refer to spectrum analyzer plots. Data shows out of band emissions are suppressed well below the -20 dBc minimum required by the Rules.

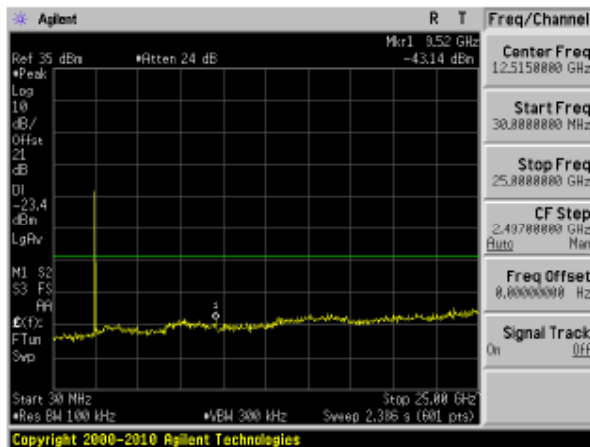
TX Spurious Emissions LOW Channel



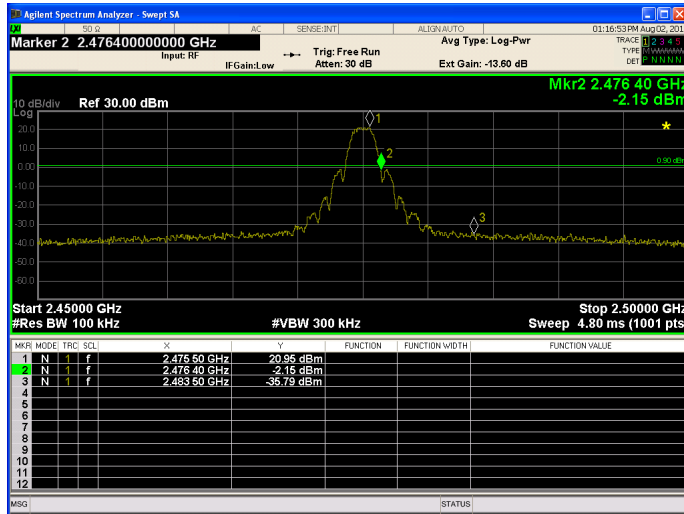
TX Spurious, MID Channel



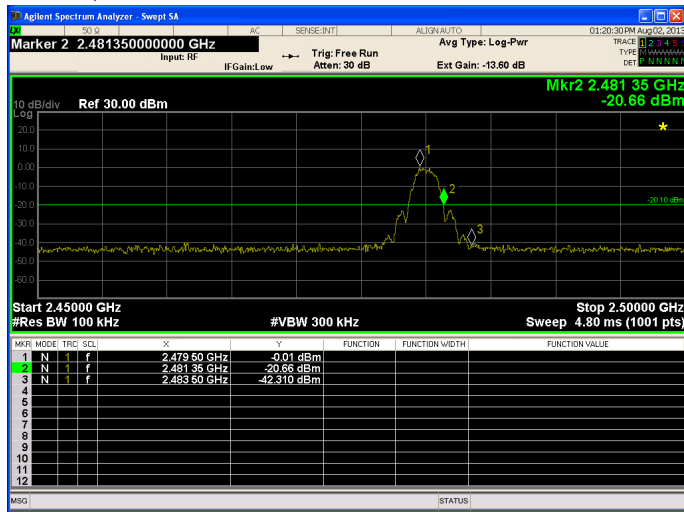
TX Spurious, HIGH Channel



Band Edge emissions, CH 25
 CH 25, ats112=12



Band Edge emissions, CH 26
 CH 26, ats112=3



END OF REPORT

Report Revision History

Revision No.	Revision Description	Pages Revised	Revised by	Date
-	Original issue		T. Cokenias	11 July 2013
1	Model number correction in header Update equipment list Correction to antenna factors Add Ch.25 power, Ch 25 and 26 spurious Editorial corrections Add model number cross reference	2, 3,15-19 Annex A	T. Cokenias T. Cokenias	2 August 2013

ANNEX A

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