

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-NIC711
IC: 5975A-NIC711
Model No.: NIC411
Application type: Class 2 permissive change

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Silver Spring Networks (SSN) model NIC411 is a radio module for electric power meter communications use. The module incorporates a 900 MHz frequency hopping spread spectrum mesh network radio.

This report is for a Class 2 permissive change. The internal antenna gain has changed, and the front end has been replaced with a new RFMD front end module (FEM) that is pin compatible with the original front end.

III. TEST DATES AND TEST LOCATION

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

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

25 July 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.

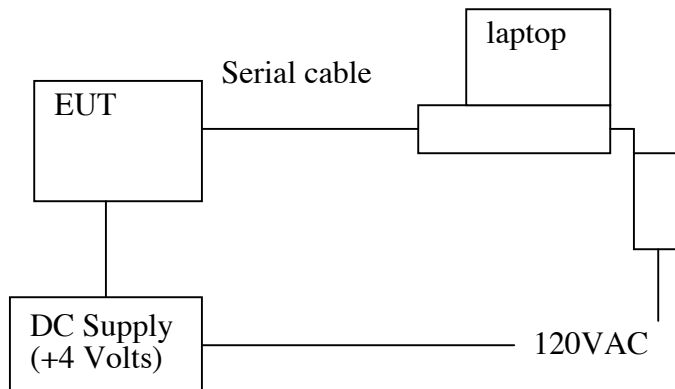
Test Equipment

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

Manufacturer	Description	Model No.	Serial No.	Calibration Due
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2014-03-22
Agilent	Spectrum Analyzer	E4446A	US44300386	2013-09-29
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2013-06-18
EMCO	Horn antenna	3115	9511-4627	2013-10-03
Hewlett Packard	Pre amplifier	8447D	2944A06639	2013-06-09
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2014-01-29

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

900 MHz FREQUENCY HOPPING SPREAD SPECTRUM RADIO EMISSIONS

The 900 MHz FHSS radiated spurious emissions were measured for both internal and external antenna operation. Worst-case radiated emissions were for 300 kbps setting and are reported here.

TEST RESULTS

Radiated Test Set-up, 30 MHz-9.3 GHz

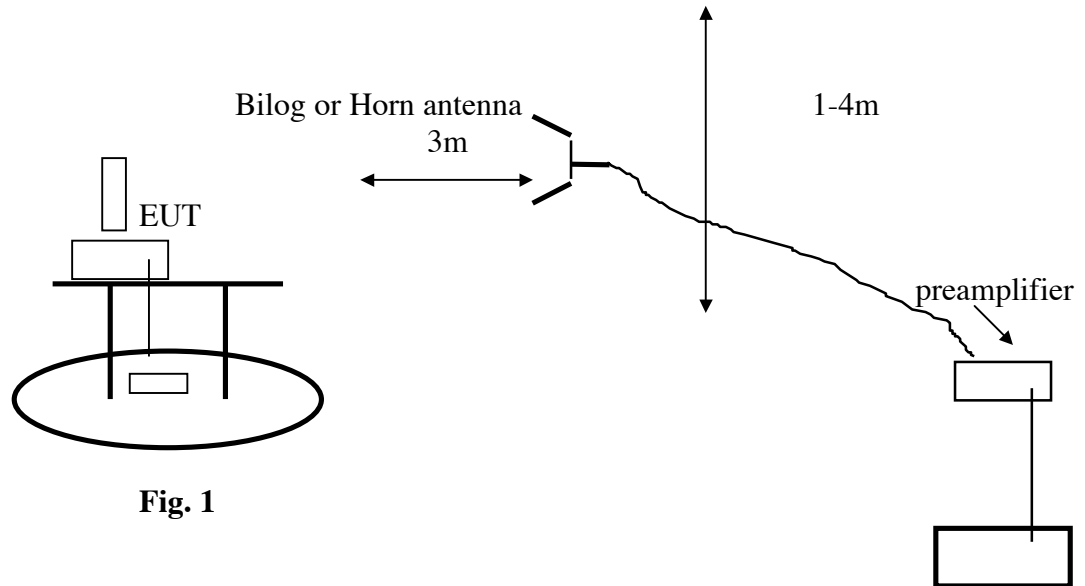


Fig. 1

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 (300 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
Product Type: Board
Project Number: T1305022
Tester: Wei Sun
Date: 2013-05-02

Horn antenna: DRH118
Amplifier: mini circuit 570400946, HP 8447D SN: 2944a06039
Spectrum Analyzer: MY44303352
cable: SPS-2303-3840-SPS 32 feet, chamber 3 below 1 Ghz cable, RF cable SN: 10

FCC 15 C in 5 M Chamber 3 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 902.4 MHz measured at 3 meters GFSK Modulation External Antenna, 300 kbps data rate MAC: 0013500200A6FF3E Part Number: 174-0396 REV 07											
1804.8	57.56	301	100	V	25.92	3.41	27.67	59.22		59.22	Peak
1804.8	56.87	301	100	V	25.92	3.41	27.67	58.53		58.53	Ave
1804.8	53.55	91	100	H	25.92	3.41	27.67	55.21		55.21	Peak
1804.8	52.58	91	100	H	25.92	3.41	27.67	54.24		54.24	Ave
2707.2	43.43	314	100	V	29.56	4.15	27.85	49.29	74	-24.71	Peak
2707.2	39.77	314	100	V	29.56	4.15	27.85	45.63	54	-8.37	Ave
2707.2	44.3	253	100	H	29.56	4.15	27.85	50.16	74	-23.84	Peak
2707.2	40.91	253	100	H	29.56	4.15	27.85	46.77	54	-7.23	Ave
3609.6	39.88	51	100	V	30.97	4.84	27.96	47.73	74	-26.27	Peak
3609.6	34.37	51	100	V	30.97	4.84	27.96	42.22	54	-11.78	Ave
3609.6	38.64	66	100	H	30.97	4.84	27.96	46.49	74	-27.51	Peak
3609.6	31.06	66	100	H	30.97	4.84	27.96	38.91	54	-15.09	Ave
4512	36.09	74	100	V	31.79	5.56	27.88	45.56	74	-28.44	Peak
4512	29.01	74	100	V	31.79	5.56	27.88	38.48	54	-15.52	Ave
4512	34.07	291	100	H	31.79	5.56	27.88	43.54	74	-30.46	Peak
4512	23.11	291	100	H	31.79	5.56	27.88	32.58	54	-21.42	Ave
5414.4	30	0	100	V	34.39	6.03	27.62	42.8	74	-31.2	Peak
5414.4	20	0	100	V	34.39	6.03	27.62	32.8	54	-21.2	Ave
5414.4	30	0	100	H	34.39	6.03	27.62	42.8	74	-31.2	Peak
5414.4	20	0	100	H	34.39	6.03	27.62	32.8	54	-21.2	Ave

Middle channel 915.2 MHz measured at 3 meters GFSK Modulation External Antenna, 300 kbps data rate MAC: 0013500200A6FF3E Part Number: 174-0396 REV 07											
1830.4	52.38	312	100	V	25.92	3.4	27.68	54.02		54.02	Peak
1830.4	51.31	312	100	V	25.92	3.4	27.68	52.95		52.95	Ave
1830.4	48.52	2	100	H	25.92	3.4	27.68	50.16		50.16	Peak
1830.4	46.97	2	100	H	25.92	3.4	27.68	48.61		48.61	Ave
2745.6	39.69	355	100	V	29.56	4.15	27.84	45.56	74	-28.44	Peak
2745.6	31.69	355	100	V	29.56	4.15	27.84	37.56	54	-16.44	Ave
2745.6	40.12	251	100	H	29.56	4.15	27.84	45.99	74	-28.01	Peak
2745.6	32.94	251	100	H	29.56	4.15	27.84	38.81	54	-15.19	Ave
3660.8	41.76	54	100	V	30.92	4.83	27.96	49.55	74	-24.45	Peak
3660.8	36.45	54	100	V	30.92	4.83	27.96	44.24	54	-9.76	Ave
3660.8	40.09	67	100	H	30.92	4.83	27.96	47.88	74	-26.12	Peak
3660.8	34.07	67	100	H	30.92	4.83	27.96	41.86	54	-12.14	Ave
4576	35.63	78	100	V	31.82	5.54	27.84	45.15	74	-28.85	Peak
4576	27.57	78	100	V	31.82	5.54	27.84	37.09	54	-16.91	Ave
4576	33.47	177	100	H	31.82	5.54	27.84	42.99	74	-31.01	Peak
4576	22.69	177	100	H	31.82	5.54	27.84	32.21	54	-21.79	Ave
5491.2	30	0	100	V	34.34	6.08	27.6	42.82		42.82	Peak
5491.2	20	0	100	V	34.34	6.08	27.6	32.82		32.82	Ave
5491.2	30	0	100	H	34.34	6.08	27.6	42.82		42.82	Peak
5491.2	20	0	100	H	34.34	6.08	27.6	32.82		32.82	Ave
915.2	102.21	90	100	V	22.09	1.87	0	126.17		126.17	Peak

High channel 927.6 MHz measured at 3 meters GFSK Modulation External Antenna, 300 kbps data rate MAC: 0013500200A6FF3E Part Number: 174-0396 REV 07											
1855.2	51.66	339	100	V	26.64	3.4	27.73	53.97		53.97	Peak
1855.2	50.21	339	100	V	26.64	3.4	27.73	52.52		52.52	Ave
1855.2	47.48	1	100	H	26.64	3.4	27.73	49.79		49.79	Peak
1855.2	45.47	1	100	H	26.64	3.4	27.73	47.78		47.78	Ave
2782.8	30	0	100	V	29.44	4.26	27.81	35.89	74	-38.11	Peak
2782.8	20	0	100	V	29.44	4.26	27.81	25.89	54	-28.11	Ave
2782.8	30	0	100	H	29.44	4.26	27.81	35.89	74	-38.11	Peak
2782.8	20	0	100	H	29.44	4.26	27.81	25.89	54	-28.11	Ave
3710.4	44.75	52	100	V	30.92	4.98	27.96	52.69	74	-21.31	Peak
3710.4	41.68	52	100	V	30.92	4.98	27.96	49.62	54	-4.38	Ave
3710.4	41.99	55	100	H	30.92	4.98	27.96	49.93	74	-24.07	Peak
3710.4	37.92	55	100	H	30.92	4.98	27.96	45.86	54	-8.14	Ave
4638	34.67	144	100	V	31.82	5.57	27.79	44.27	74	-29.73	Peak
4638	23.05	144	100	V	31.82	5.57	27.79	32.65	54	-21.35	Ave
4638	30	0	100	H	31.82	5.57	27.79	39.6	74	-34.4	Peak
4638	20	0	100	H	31.82	5.57	27.79	29.6	54	-24.4	Ave
5565.6	38.62	311	100	V	34.1	6.09	27.56	51.25		51.25	Peak
5565.6	32.5	311	100	V	34.1	6.09	27.56	45.13		45.13	Ave
5565.6	35.71	33	100	H	34.1	6.09	27.56	48.34		48.34	Peak



Company Name: Silver Spring Networks
Product Type: Board
Project Number: T1305161
Tester: Wei Sun
Date: 2013-05-16

Horn antenna: 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, RF cable SN: 10

FCC 15 C in 5 M Chamber 3 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 902.4 MHz measured at 3 meters GFSK Modulation Internal Antenna, 300 kbps data rate MAC: 0013500200A6FF3E Part Number: 174-0396 REV 07											
1804.8	51.81	81	100	V	27.2	3.41	27.67	54.75		54.75	Peak
1804.8	50.55	81	100	V	27.2	3.41	27.67	53.49		53.49	Ave
1804.8	51.16	121	100	H	27.2	3.41	27.67	54.1		54.1	Peak
1804.8	49.75	121	100	H	27.2	3.41	27.67	52.69		52.69	Ave
2707.2	44.12	216	100	V	29.21	4.15	27.85	49.63	74	-24.37	Peak
2707.2	38.755	216	100	V	29.21	4.15	27.85	44.265	54	-9.735	Ave
2707.2	50.42	122	100	H	29.21	4.15	27.85	55.93	74	-18.07	Peak
2707.2	48.24	122	100	H	29.21	4.15	27.85	53.75	54	-0.25	Ave
3609.6	36.42	224	100	V	31.54	4.84	27.96	44.84	74	-29.16	Peak
3609.6	26.73	224	100	V	31.54	4.84	27.96	35.15	54	-18.85	Ave
3609.6	35.96	62	100	H	31.54	4.84	27.96	44.38	74	-29.62	Peak
3609.6	23.78	62	100	H	31.54	4.84	27.96	32.2	54	-21.8	Ave
4512	34.88	229	100	V	32.47	5.56	27.88	45.03	74	-28.97	Peak
4512	25.17	229	100	V	32.47	5.56	27.88	35.32	54	-18.68	Ave
4512	34.22	111	100	H	32.47	5.56	27.88	44.37	74	-29.63	Peak
4512	23.69	111	100	H	32.47	5.56	27.88	33.84	54	-20.16	Ave
5414.4	30	0	100	V	34.44	6.03	27.62	42.85	74	-31.15	Peak
5414.4	20	0	100	V	34.44	6.03	27.62	32.85	54	-21.15	Ave
5414.4	30	0	100	H	34.44	6.03	27.62	42.85	74	-31.15	Peak
5414.4	20	0	100	H	34.44	6.03	27.62	32.85	54	-21.15	Ave
Middle channel 915.2 MHz measured at 3 metersGFSK Modulation Internal Antenna, 300 kbps data rate MAC: 0013500200A6FF3E Part Number: 174-0396 REV 07											
1830.4	50.84	59	100	V	27.2	3.4	27.68	53.76		53.76	Peak
1830.4	49.49	59	100	V	27.2	3.4	27.68	52.41		52.41	Ave
1830.4	51.41	121	100	H	27.2	3.4	27.68	54.33		54.33	Peak
1830.4	50.24	121	100	H	27.2	3.4	27.68	53.16		53.16	Ave
2745.6	44.81	159	100	V	29.21	4.15	27.84	50.33	74	-23.67	Peak
2745.6	41.02	159	100	V	29.21	4.15	27.84	46.54	54	-7.46	Ave
2745.6	41.39	120	100	H	29.21	4.15	27.84	46.91	74	-27.09	Peak
2745.6	45.01	120	100	H	29.21	4.15	27.84	50.53	54	-3.47	Ave
3660.8	37.97	321	100	V	32.07	4.83	27.96	46.91	74	-27.09	Peak
3660.8	27.57	321	100	V	32.07	4.83	27.96	36.51	54	-17.49	Ave
3660.8	37.33	119	100	H	32.07	4.83	27.96	46.27	74	-27.73	Peak
3660.8	26.6	119	100	H	32.07	4.83	27.96	35.54	54	-18.46	Ave
4576	35.67	93	100	V	32.47	5.54	27.84	45.84	74	-28.16	Peak
4576	24.91	93	100	V	32.47	5.54	27.84	35.08	54	-18.92	Ave
4576	33.7	252	100	H	32.47	5.54	27.84	43.87	74	-30.13	Peak
4576	23.28	252	100	H	32.47	5.54	27.84	33.45	54	-20.55	Ave
5491.2	30	0	100	V	34.4	6.08	27.6	42.88		42.88	Peak
5491.2	20	0	100	V	34.4	6.08	27.6	32.88		32.88	Ave
5491.2	30	0	100	H	34.4	6.08	27.6	42.88		42.88	Peak
5491.2	20	0	100	H	34.4	6.08	27.6	32.88		32.88	Ave
High channel 927.6 MHz measured at 3 meters GFSK Modulation Internal Antenna, 300 kbps data rate MAC: 0013500200A6FF3E Part Number: 174-0396 REV 07											
1855.2	51.94	62	100	V	27.77	3.4	27.73	55.38		55.38	Peak
1855.2	50.58	62	100	V	27.77	3.4	27.73	54.02		54.02	Ave
1855.2	52.06	123	100	H	27.77	3.4	27.73	55.5		55.5	Peak
1855.2	50.47	123	100	H	27.77	3.4	27.73	53.91		53.91	Ave
2782.8	30	0	100	V	29.26	4.26	27.81	35.71	74	-38.29	Peak
2782.8	20	0	100	V	29.26	4.26	27.81	25.71	54	-28.29	Ave
2782.8	30	0	100	H	29.26	4.26	27.81	35.71	74	-38.29	Peak
2782.8	20	0	100	H	29.26	4.26	27.81	25.71	54	-28.29	Ave
3710.4	39.62	306	100	V	32.07	4.98	27.96	48.71	74	-25.29	Peak
3710.4	33.53	306	100	V	32.07	4.98	27.96	42.62	54	-11.38	Ave
3710.4	38.86	243	100	H	32.07	4.98	27.96	47.95	74	-26.05	Peak
3710.4	31.93	243	100	H	32.07	4.98	27.96	41.02	54	-12.98	Ave
4638	34.15	122	100	V	32.47	5.57	27.79	44.4	74	-29.6	Peak
4638	22.88	122	100	V	32.47	5.57	27.79	33.13	54	-20.87	Ave
4638	33.26	131	100	H	32.47	5.57	27.79	43.51	74	-30.49	Peak
4638	21.79	131	100	H	32.47	5.57	27.79	32.04	54	-21.96	Ave
5565.6	30	0	100	V	34.29	6.09	27.56	42.82		42.82	Peak
5565.6	20	0	100	V	34.29	6.09	27.56	32.82		32.82	Ave
5565.6	30	0	100	H	34.29	6.09	27.56	42.82		42.82	Peak
5565.6	20	0	100	H	34.29	6.09	27.56	32.82		32.82	Ave

Radiated Emissions Below 1 GHZ

All TX emissions more than 20 dB below limits

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) (2) For frequency hopping systems operating in the 902-928 MHz band, employing at least 50 hopping channels: 1 watt; and employing less than 50 hopping channels, but at least 25 hopping channels: 0.25 watt.

§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 3 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.

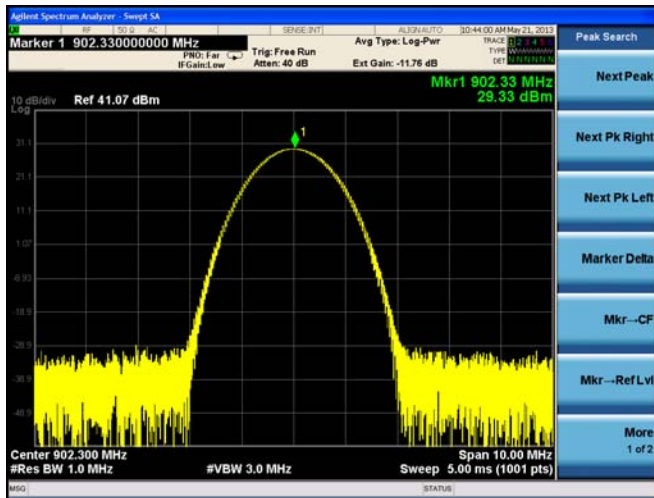
RESULTS

No non-compliance noted:

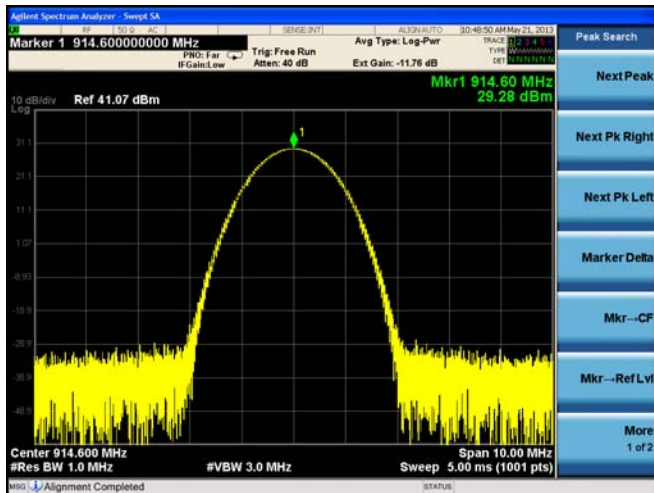
Channel	Frequency	P out
Low	902.3	29.33
Mid	914.9	29.28
High	926.9	29.92

Note: Power output equal for all hopping channel separation modes. Data presented for 300 kHz channel separation mode as most typical worst case.

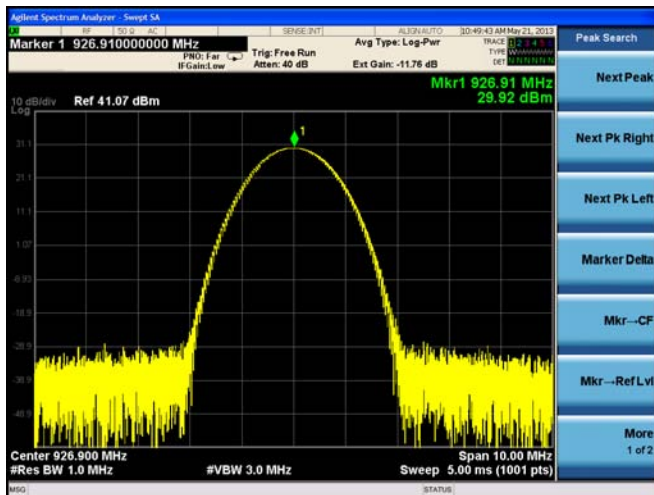
OUTPUT POWER LOW CHANNEL



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:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = 100 * d \text{ (m)}$$

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/cm²

Substituting the logarithmic form of power and gain using:

$$P \text{ (mW)} = 10^{(P \text{ (dBm)} / 10)} \text{ and}$$

$$G \text{ (numeric)} = 10^{(G \text{ (dBi)} / 10)}$$

yields

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

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm²

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

LIMITS

From §1.1310 Table 1 (B), $S = 0.6 \text{ mW/cm}^2$

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
0.6	29.92	3	0.390	16.1

Maximum MPE calculated for external 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.

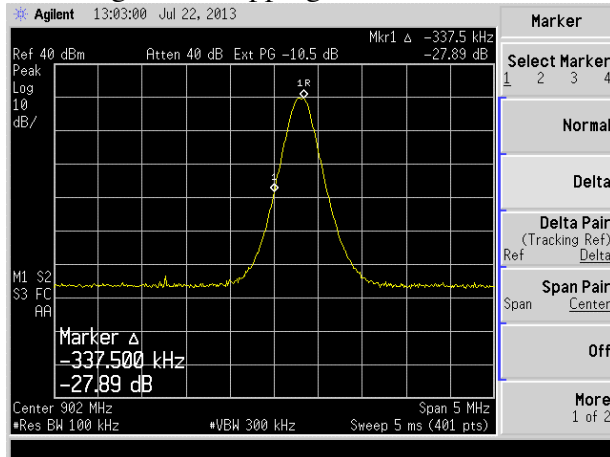
The spectrum from 30 MHz to 10 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

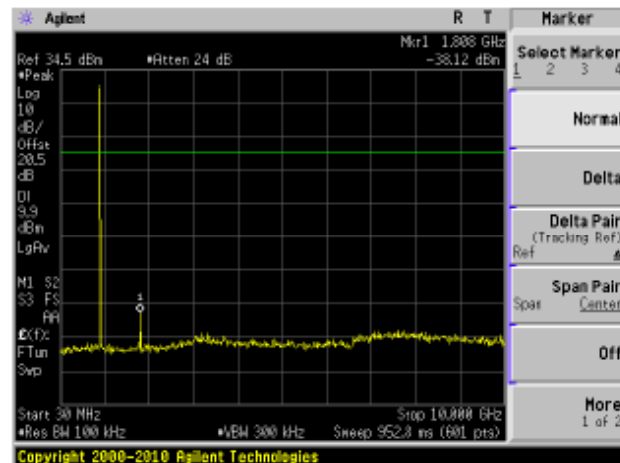
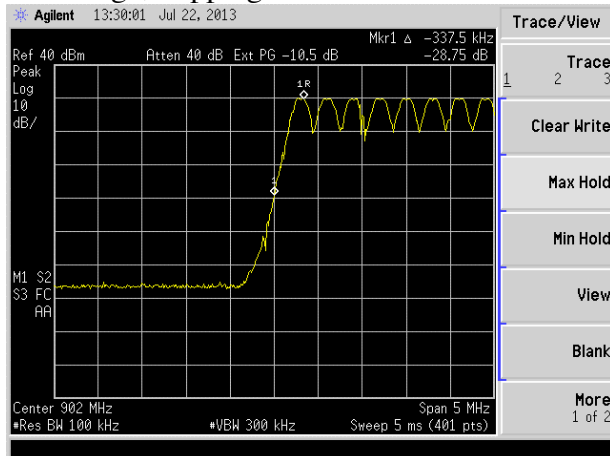
No non-compliance noted:

SPURIOUS EMISSIONS, LOW CHANNEL

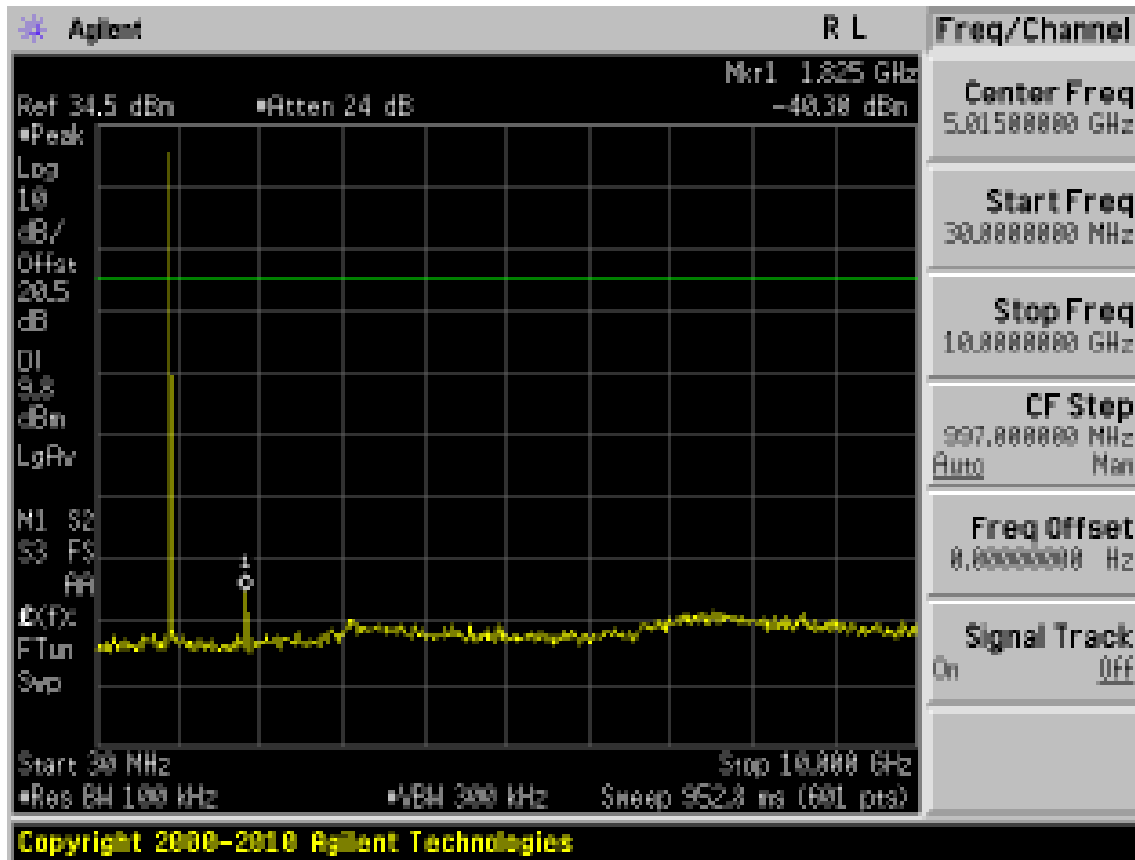
Band edge, non-hopping



Band edge, hopping function activated

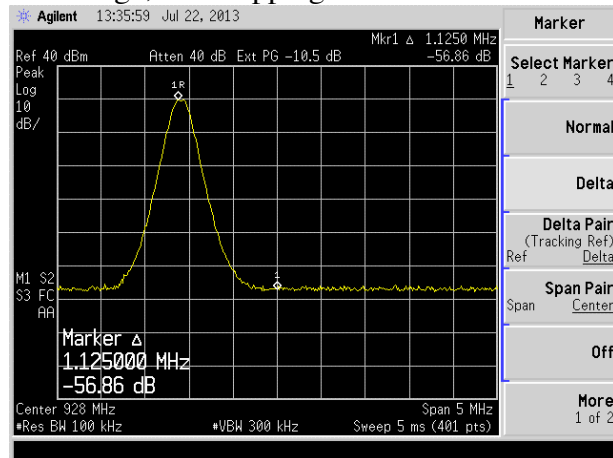


SPURIOUS EMISSIONS, MID CHANNEL

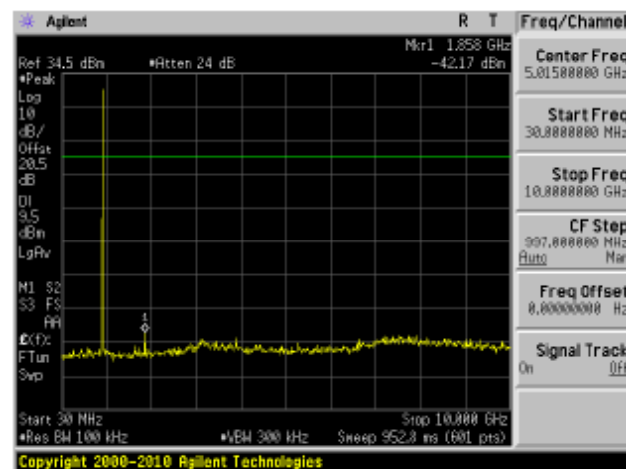
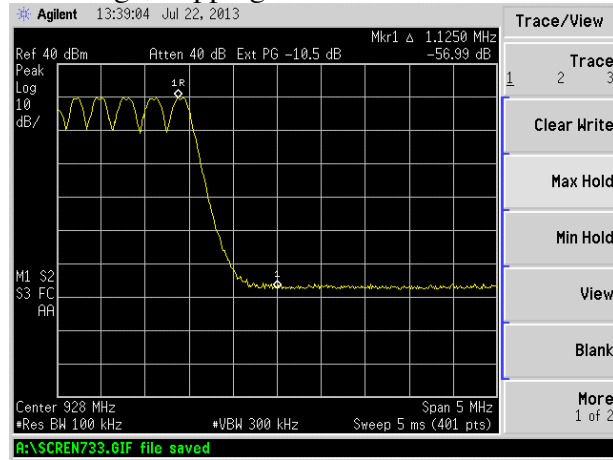


SPURIOUS EMISSIONS, HIGH CHANNEL

Band edge, non-hopping



Band edge, hopping function activated



END OF REPORT

Report Revision History

Revision No.	Revision Description	Pages Revised	Revised by	Date
-	Original		T. Cokenias	07/13/2013
1	Remove incorrect 5 dBi reference Add upper and lower channel band edge spurious plots	14, 16-18	T. Cokenias	7/22/2013
2	Correct integral antenna information p.2 Add 2.4 GHz band gain	2	T.Cokenias	7/25/2013