EMISSIONS TEST REPORT FOR A LOW POWER TRANSMITTER

I. GENERAL INFORMATION

Requirement:	FCC, Industry Canada
Test Requirements:	FCC: Part 2, Part 15 IC: RSS-Gen, RSS-210,
Applicant:	Silver Spring Networks 575 Broadway Street Redwood City, CA 94063
FCC ID:	**OWS-IMU516**
IC:	5975A-IMU516
Model No.:	174-000140

II. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Silver Spring Networks (SSN) IMU516 is a battery-operated radio module for gas meter communications use. The board incorporates a 900 MHz FHSS radio.

III. TEST DATES AND TEST LOCATION

Antenna port conducted and radiated emissions tests below 1 GHz were performed at Compliance Certification Services in Fremont, CA on 7 and 17 September 2010 and 2 May 2011.

Hopping mode tests and antenna port conducted TX spurious tests were performed at Silver Spring Networks on 14 June 2010.

Radiated emissions tests above 1 GHz were performed 24 March 2011 at BACL in Sunnyvale, CA

T.N. Cokenias 2 May 2011
EMC Consultant/Agent for Silver Spring Networks

15.203 Antenna connector requirement

The EUT uses a custom permanently attached integral antenna,

Antenna description	Mfr.	Model No.	Gain
Built-in sheet metal electric meter	SSN	n/a	3 dBi at 902 MHz

TEST PROCEDURES

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

FCC 47CFR15

RSS-Gen, Issue 3: General Requirements and Informationfor the Certification of Radio Apparatus (December 2010)
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.

Tests were performed at three frequencies:

Channel 0 (LOW) – 902.3 MHz
Channel 43 (MID) -915.2 MHz
Channel 82 (HIGH) – 926.9 MHz

Test Equipment

Compliance Certification Services:

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset Number**	**Cal Due**
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01179	08/18/11
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	07/12/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	01/06/11
Antenna, Horn, 18 GHz	EMCO	3115	C00945	06/29/11
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	07/14/11
Power Meter	Agilent / HP	437B	N02778	08/11/12

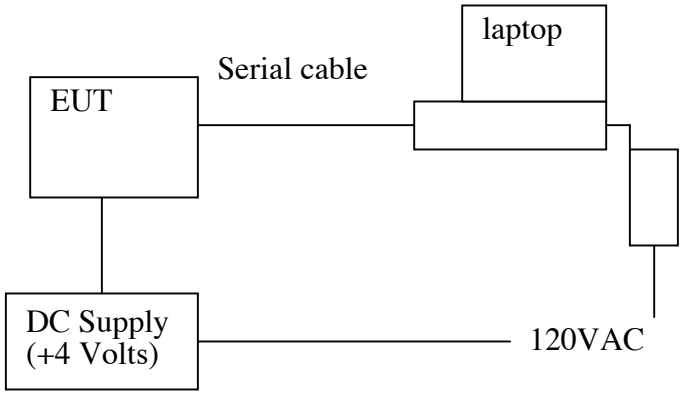
Silver Spring Networks:

Equipment	Mfr	Model	Asset No.	Cal Due
Analyzer	Agilent	CXA	MY49370322	03/07/2011

BACL

Manufacturer	**Description**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Agilent	Analyzer	E4440A	US45303156	8/10/10	8/10/11
Sunol Science	Controller	SC99V	122303-1	N/R	N/R
Wainwright Inst.	Notch filter	WRCGV 900	1	N/R	N/R
Sunol Science	Bilog Antenna	JB3	A0020106-3	6/17/10	6/17/11
Hewlett Packard	Pre amplifier	8447D	2944A06639	6/19/10	6/19/11
A.R.A Inc	Horn antenna	DRG-1181A	1132	11/30/10	11/30/11
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	5/13/10	5/13/11

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

FREQUENCY HOPPING SPREAD SPECTRUM
RADIO EMISSIONS

TEST RESULTS
Radiated Test Set-up, 30 MHz-9.3 GHz
FCC: 15.109, 15.205, 15.209
IC: RSS-Gen, Sec. 6.1, 7.7.2

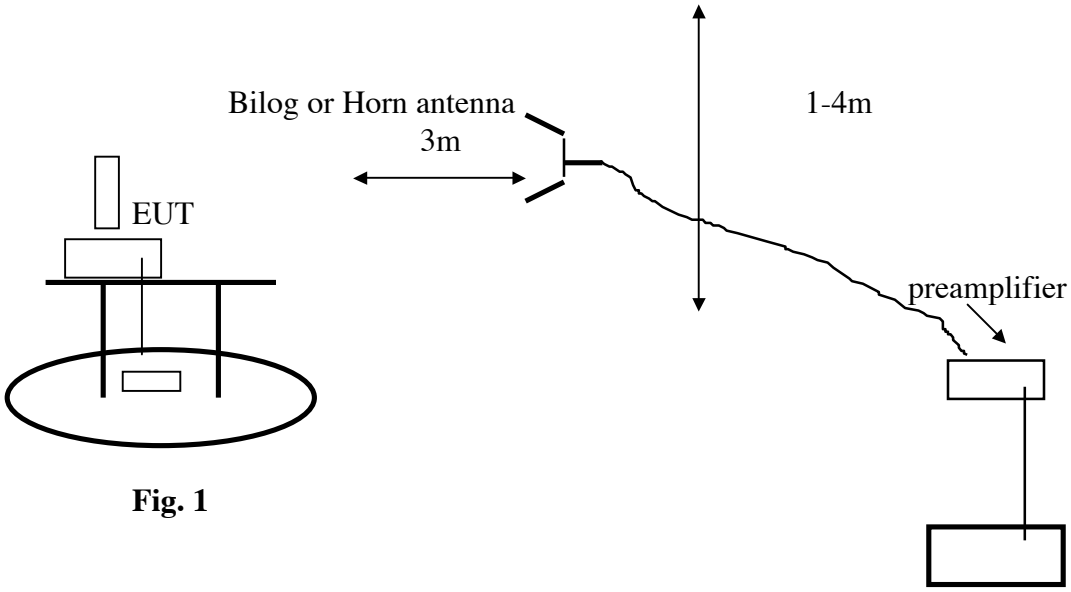


Fig. 1

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 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

Transmitter Radiated Emissions Above 1 GHz

External IMU

Low channel: 902.3

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
2707	43.57	76	100	V	29.5	6.3	27.9	51.47	74	-22.53	peak
2707	38.49	360	100	H	29.5	6.3	27.9	46.39	74	-27.61	peak
2707	35.89	76	100	V	29.5	6.3	27.9	43.79	54	-10.21	ave
2707	25.22	360	100	H	29.5	6.3	27.9	33.12	54	-20.88	ave
1804.5	52.53	166	100	V	25.6	4.975	27.6	55.505	74	-18.495	peak
1804.5	52.34	155	100	H	25.6	4.975	27.6	55.315	74	-18.685	peak
1804.5	51.24	166	100	V	25.6	4.975	27.6	54.215	54	0.215	ave
1804.5	50.68	155	100	H	25.6	4.975	27.6	53.655	54	-0.345	ave

Mid Channel 915.3MHz

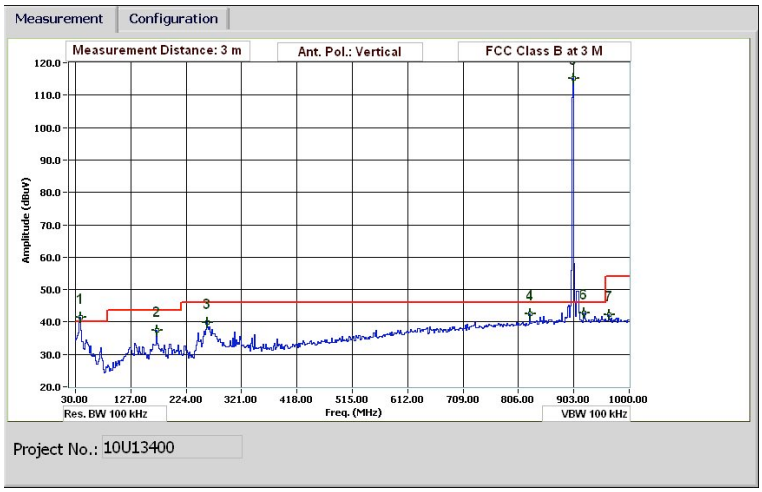
Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
2745.9	43.24	125	100	V	29.5	6.3	27.9	51.14	74	-22.86	peak
2745.9	42.22	198	153	H	29.5	6.3	27.9	50.12	74	-23.88	peak
2745.9	36.11	125	100	V	29.5	6.3	27.9	44.01	54	-9.99	ave
2745.9	35.69	198	153	H	29.5	6.3	27.9	43.59	54	-10.41	ave
1830.6	65.26	147	100	V	25.6	4.975	27.6	68.235	74	-5.765	peak
1830.6	59.55	104	100	H	25.6	4.975	27.6	62.525	74	-11.475	peak
1830.6	64.91	147	100	V	25.6	4.975	27.6	67.885	54	13.885	ave
1830.6	58.92	104	100	H	25.6	4.975	27.6	61.895	54	7.895	ave

High Channel 926.9MHz

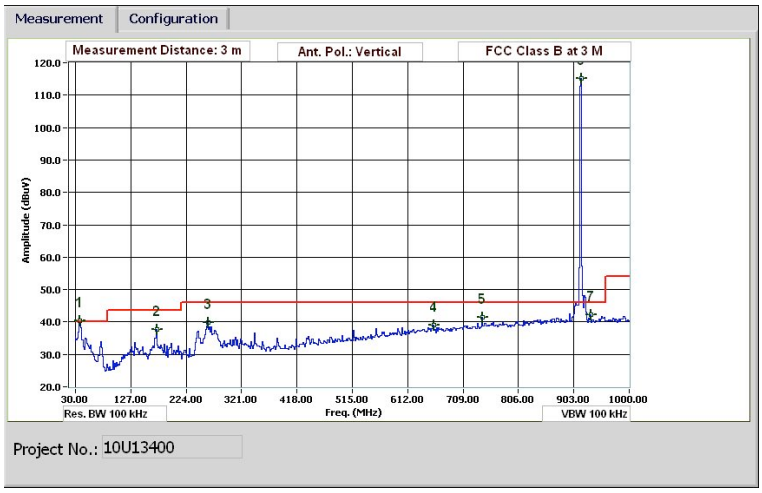
Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
1854	59.71	154	100	V	25.6	4.975	27.6	62.685	74	-11.315	peak
1854	59.1	194	114	H	25.6	4.975	27.6	62.075	74	-11.925	peak
1854	56.05	154	100	V	25.6	4.975	27.6	59.025	54	5.025	ave
1854	55.19	194	114	H	25.6	4.975	27.6	58.165	54	4.165	ave

TX Radiated Emissions Below 1 GHZ

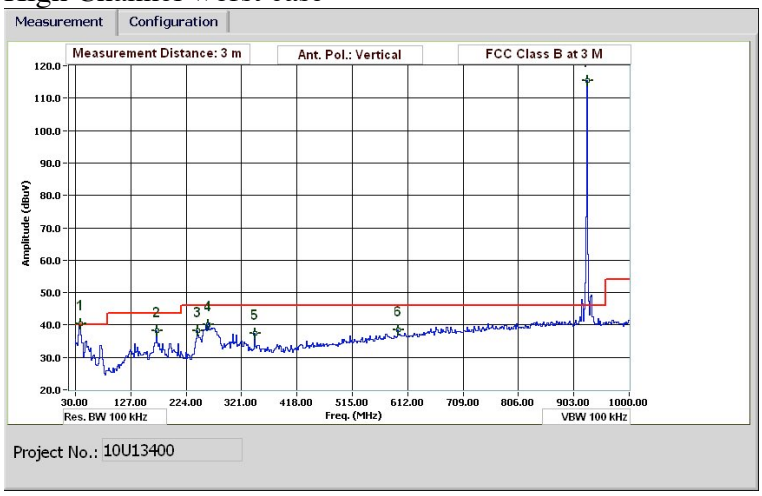
Low Channel worst case



Mid Channel worst case



High Channel worst case



TX Radiated Emissions Below 1 GHZ

30-1000MHz Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Doug Anderson
Date: 09/03/10
Project #: 10U13400
Company: Silver Springs Networks
Test Target: FCC Class B
Mode Oper: Continuous Transmit

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Pad dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant. High cm	Table Angle Degree	Notes
Run 1: Low Channel (902.3 MHz) / Vertical				11.0											
39.700	3.0	55.1	14.1	0.6	28.4	0.0	0.0	41.4	95.0	-53.6	V	P			
172.267	3.0	53.8	10.6	1.2	28.2	0.0	0.0	37.4	43.5	-6.1	V	P			
261.183	3.0	54.4	12.2	1.4	28.2	0.0	0.0	39.8	46.0	-6.2	V	P			
827.017	3.0	46.3	21.2	2.7	27.5	0.0	0.0	42.6	46.0	-3.4	V	P			
903.000	3.0	118.2	21.9	2.8	27.8	0.0	0.0	115.1	115.1	0.0	V	P			
920.783	3.0	45.8	22.0	2.8	27.8	0.0	0.0	42.8	46.0	-3.2	V	P			
964.433	3.0	45.0	22.3	2.9	27.9	0.0	0.0	42.3	54.0	-11.7	V	P			
Run 2: Low Channel (Ch. 0 / 902.6 MHz) / Horizontal															
30.000	3.0	42.4	20.1	0.5	28.4	0.0	0.0	34.5	95.4	-60.9	H	P			
135.083	3.0	50.3	13.4	1.1	28.3	0.0	0.0	36.5	43.5	-7.0	H	P			
172.267	3.0	54.1	10.6	1.2	28.2	0.0	0.0	37.7	43.5	-5.8	H	P			
245.017	3.0	53.5	11.8	1.3	28.2	0.0	0.0	38.5	46.0	-7.5	H	P			
883.600	3.0	46.7	21.7	2.8	27.7	0.0	0.0	43.4	46.0	-2.6	H	P			
903.000	3.0	118.4	21.9	2.8	27.8	0.0	0.0	115.4	115.4	0.0	H	P			
920.783	3.0	47.0	22.0	2.8	27.8	0.0	0.0	44.0	46.0	-2.0	H	P			
Run 1: Mid Channel (Ch. 43 / 915.3 MHz) / Vertical															
38.083	3.0	52.8	15.4	0.6	28.4	0.0	0.0	40.4	40.0	0.4	V	P			
38.083	3.0	51.8	15.4	0.6	28.4	0.0	0.0	40.4	40.0	-0.6	V	QP			
172.267	3.0	54.3	10.6	1.2	28.2	0.0	0.0	37.8	43.5	-5.7	V	P			
262.8	3.0	54.5	12.2	1.4	28.2	0.0	0.0	39.9	46.0	-6.1	V	P			
657.267	3.0	44.8	19.1	2.4	27.3	0.0	0.0	38.9	46.0	-7.1	V	P			
742.95	3.0	46.0	20.2	2.5	27.3	0.0	0.0	41.4	46.0	-4.6	V	P			
915.933	3.0	118.2	22.0	2.8	27.8	0.0	0.0	115.2	115.2	0.0	V	P			
933.717	3.0	45.1	22.1	2.9	27.8	0.0	0.0	42.2	46.0	-3.8	V	P			
Run 2: Mid Channel (Ch. 43 / 915.3 MHz) / Horizontal															
30.000	3.0	42.3	20.1	0.5	28.4	0.0	0.0	34.5	95.5	-61.0	H	P			
172.267	3.0	54.4	10.6	1.2	28.2	0.0	0.0	37.9	43.5	-5.6	H	P			
246.633	3.0	56.0	11.8	1.4	28.2	0.0	0.0	40.9	46.0	-5.1	H	P			
264.417	3.0	54.2	12.3	1.4	28.2	0.0	0.0	39.7	46.0	-6.3	H	P			
345.250	3.0	50.8	14.1	1.6	28.1	0.0	0.0	38.4	46.0	-7.6	H	P			
671.817	3.0	46.4	19.3	2.4	27.3	0.0	0.0	40.8	46.0	-5.2	H	P			
915.933	3.0	118.5	22.0	2.8	27.8	0.0	0.0	115.5	115.5	0.0	H	P			
Run 1: High Channel (Ch. 82 / 926.9 MHz) / Vertical															
39.700	3.0	54.0	14.1	0.6	28.4	0.0	0.0	40.3	95.3	-55.0	V	P			
172.267	3.0	54.8	10.6	1.2	28.2	0.0	0.0	38.3	43.5	-5.2	V	P			
245.017	3.0	53.2	11.8	1.3	28.2	0.0	0.0	38.1	46.0	-7.9	V	P			
262.800	3.0	54.7	12.2	1.4	28.2	0.0	0.0	40.2	46.0	-5.8	V	P			
345.25	3.0	49.7	14.1	1.6	28.1	0.0	0.0	37.3	46.0	-8.7	V	P			
595.833	3.0	45.6	18.4	2.2	27.5	0.0	0.0	38.6	46.0	-7.4	V	P			
927.25	3.0	118.2	22.0	2.9	27.8	0.0	0.0	115.3	115.3	0.0	V	P			
Run 2: High Channel (Ch. 82 / 929.9 MHz) / Horizontal															
30.000	3.0	42.7	20.1	0.5	28.4	0.0	0.0	34.9	95.6	-60.7	H	P			
172.267	3.0	53.6	10.6	1.2	28.2	0.0	0.0	37.2	43.5	-6.3	H	P			
246.633	3.0	56.9	11.8	1.4	28.2	0.0	0.0	41.9	46.0	-4.1	H	P			
266.033	3.0	56.4	12.3	1.4	28.2	0.0	0.0	41.9	46.0	-4.1	H	P			
595.833	3.0	47.1	18.4	2.2	27.5	0.0	0.0	40.1	46.0	-5.9	H	P			
927.250	3.0	118.5	22.0	2.9	27.8	0.0	0.0	115.6	115.6	0.0	H	P			
946.650	3.0	45.4	22.1	2.9	27.9	0.0	0.0	42.5	46.0	-3.5	H	P			

Rev. 1.27.09
Note: No other emissions were detected above the system noise floor.

Receiver Radiated Emissions

Below1GHz

30-1000MHz Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: William Zhuang
Date: 09/17/10
Project #: 10U13413
Company:
Test Target:
Mode Oper: Rx, Mid Ch. External IMU with Battery

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Pad dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant. High cm	Table Angle Degree	Notes
31.56	3.0	29.3	19.6	0.5	29.7	0.0	0.0	19.8	40.0	-20.2	V	P	100.0	0 - 360	Prescan
55.801	3.0	41.1	7.9	0.6	29.6	0.0	0.0	20.1	40.0	-19.9	V	P	100.0	0 - 360	Prescan
97.683	3.0	38.3	9.5	0.9	29.5	0.0	0.0	19.2	43.5	-24.3	V	P	100.0	0 - 360	Prescan
114.483	3.0	35.5	12.7	1.0	29.5	0.0	0.0	19.6	43.5	-23.9	V	P	100.0	0 - 360	Prescan
195.367	3.0	36.2	11.6	1.3	28.9	0.0	0.0	20.1	43.5	-23.4	V	P	100.0	0 - 360	Prescan
243.369	3.0	33.5	11.8	1.4	28.8	0.0	0.0	17.9	46.0	-28.1	V	P	100.0	0 - 360	Prescan
620.304	3.0	30.4	18.5	2.4	29.6	0.0	0.0	21.7	46.0	-24.3	V	P	100.0	0 - 360	Prescan
31.2	3.0	29.2	19.8	0.5	29.7	0.0	0.0	19.9	40.0	-20.1	H	P	100.0	0 - 360	Prescan
114.483	3.0	37.2	12.7	1.0	29.5	0.0	0.0	21.3	43.5	-22.2	H	P	100.0	0 - 360	Prescan
143.165	3.0	36.4	13.0	1.1	29.3	0.0	0.0	21.2	43.5	-22.3	H	P	100.0	0 - 360	Prescan
214.808	3.0	37.8	11.9	1.3	28.9	0.0	0.0	22.2	43.5	-21.3	H	P	100.0	0 - 360	Prescan
243.369	3.0	37.2	11.8	1.4	28.8	0.0	0.0	21.6	46.0	-24.4	H	P	100.0	0 - 360	Prescan

Rev. 1.27.09
Note: No other emissions were detected above the system noise floor.

Above 1 GHz

All emissions to 9.3 GHz more than 20 dB below limits

20 dB Bandwidth and 99% Occupied Bandwidth

FCC: 15.247(a)1(i)
IC: RSS-210 A8.1, RSS-Gen 4.6.1

LIMIT

500 kHz maximum

99% Bandwidth

RSS-210, RSS-Gen

LIMIT

None, for reporting purposes only

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The analyzer OCC BW function was activated to measure and display both the -20 dB and the 99% Occupied Bandwidth.

RESULTS

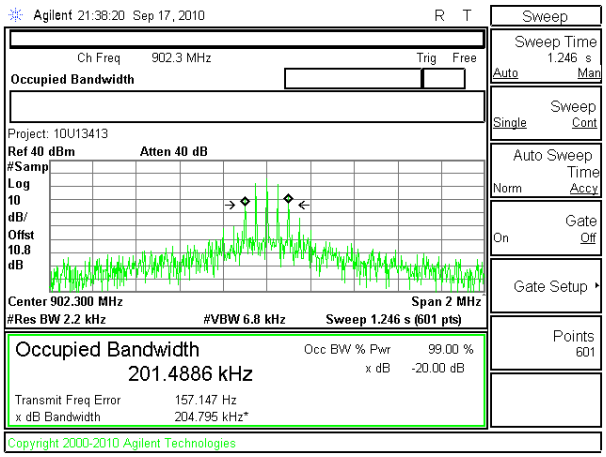
No non-compliance noted:

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	902.3	204.8
Middle	915.2	202.94
High	926.9	106.37

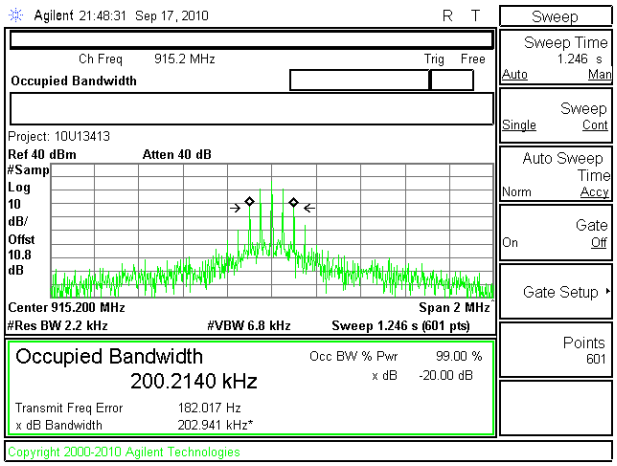
Channel	Frequency (MHz)	99% Occ BW (kHz)
Low	902.3	201.48
Middle	915.2	200.21
High	926.9	197.82

Emission Designator: 205KF1D

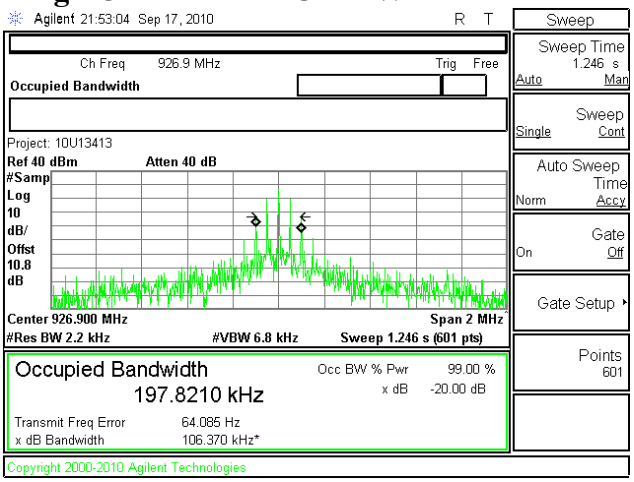
Low Channel 99% and -20 dBc Occ. BW



Mid Channel 99% Occ BW



High Channel 99% Occ BW



Emission designator: 201KF1D

HOPPING FREQUENCY SEPARATION

FCC: 15.247(a)1
IC: RSS-210 A8.1(a)

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

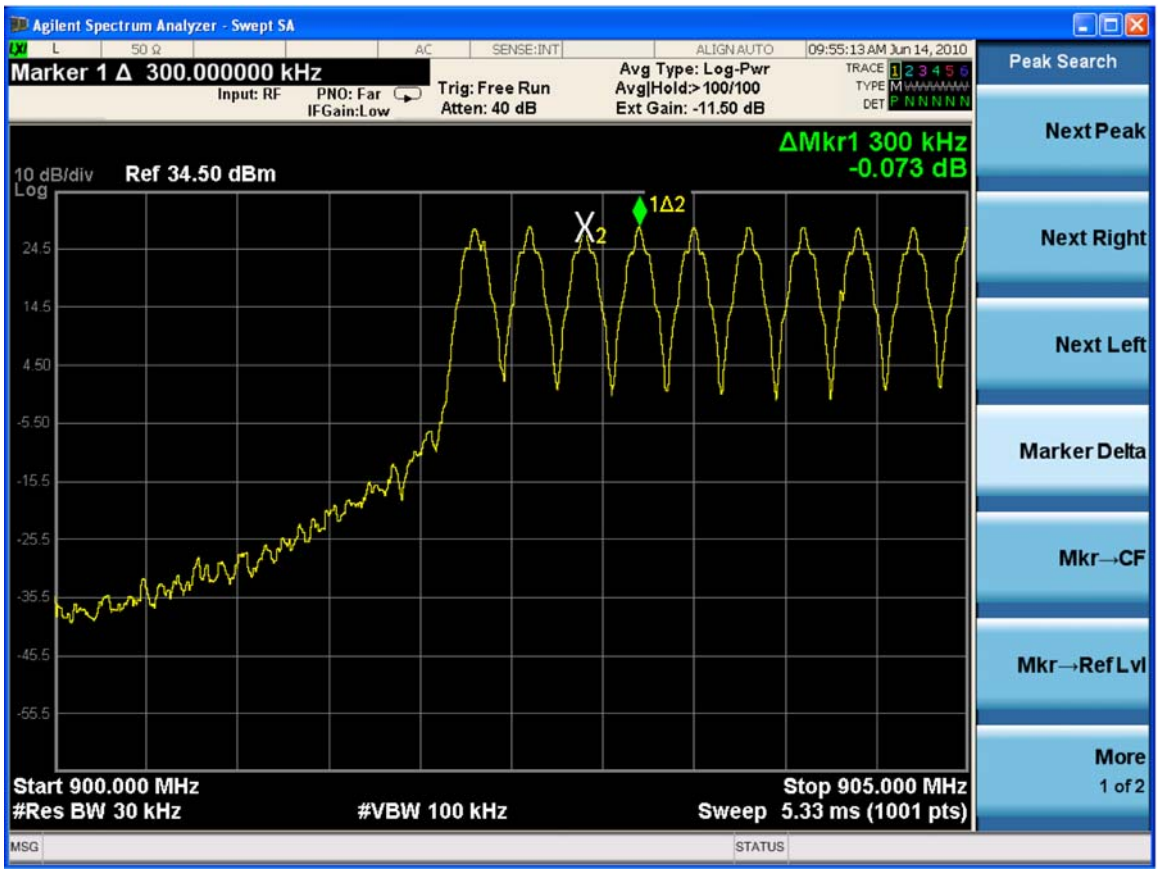
The transmitter output is connected to a spectrum analyzer. The RBW is set to 30 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

No non-compliance noted:

The separation is 300 kHz.

HOPPING FREQUENCY SEPARATION



NUMBER OF HOPPING CHANNELS

FCC: 15.247 (a)1(i)
IC: RSS 210 A8.1(b)

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

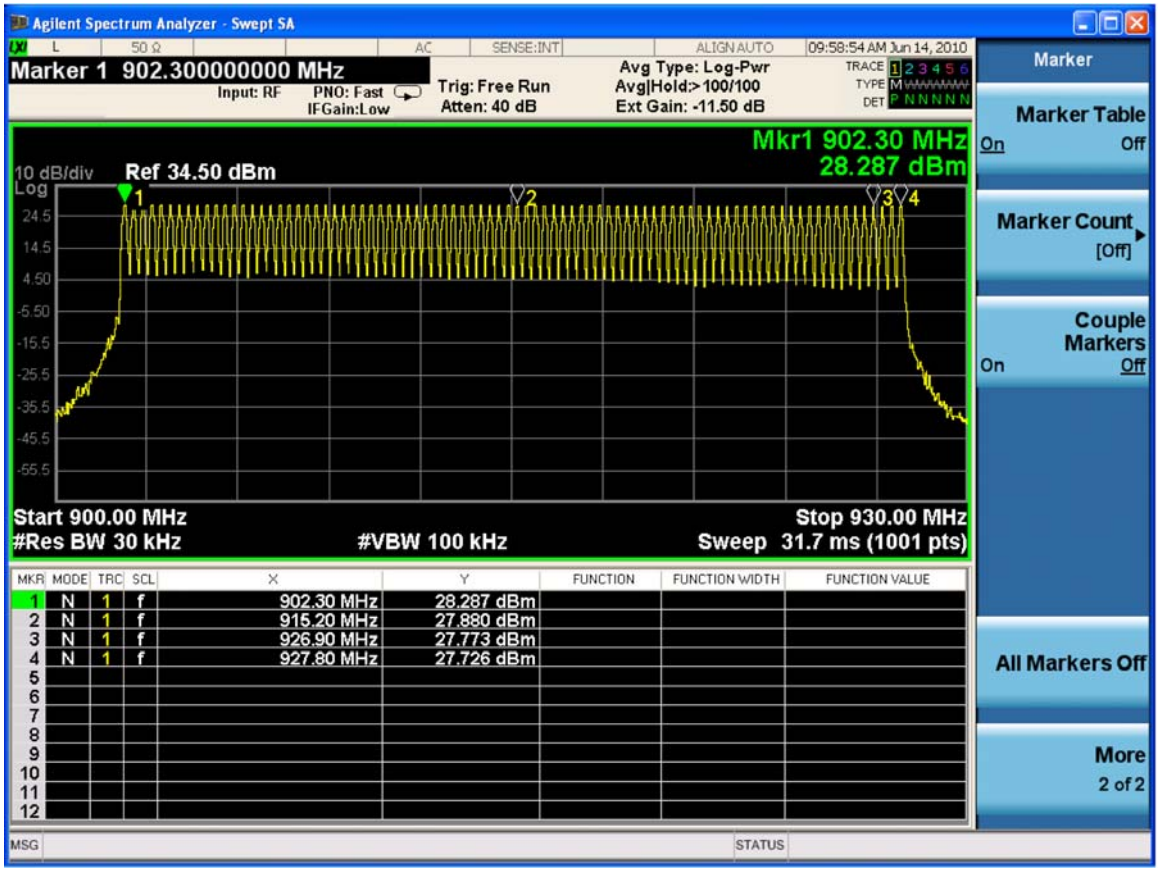
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to 30 kHz. The analyzer is set to Max Hold.

RESULTS

No non-compliance noted:

86 channels total, channels 0-82 are US channels (902.3 – 926.9 MHz). Channels 43 – 86 are frequencies authorized for use in Australia.

NUMBER OF HOPPING CHANNELS



AVERAGE TIME OF OCCUPANCY

FCC: 15.247(a)1(i)
IC: RSS 210 A8.1(c)

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 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.

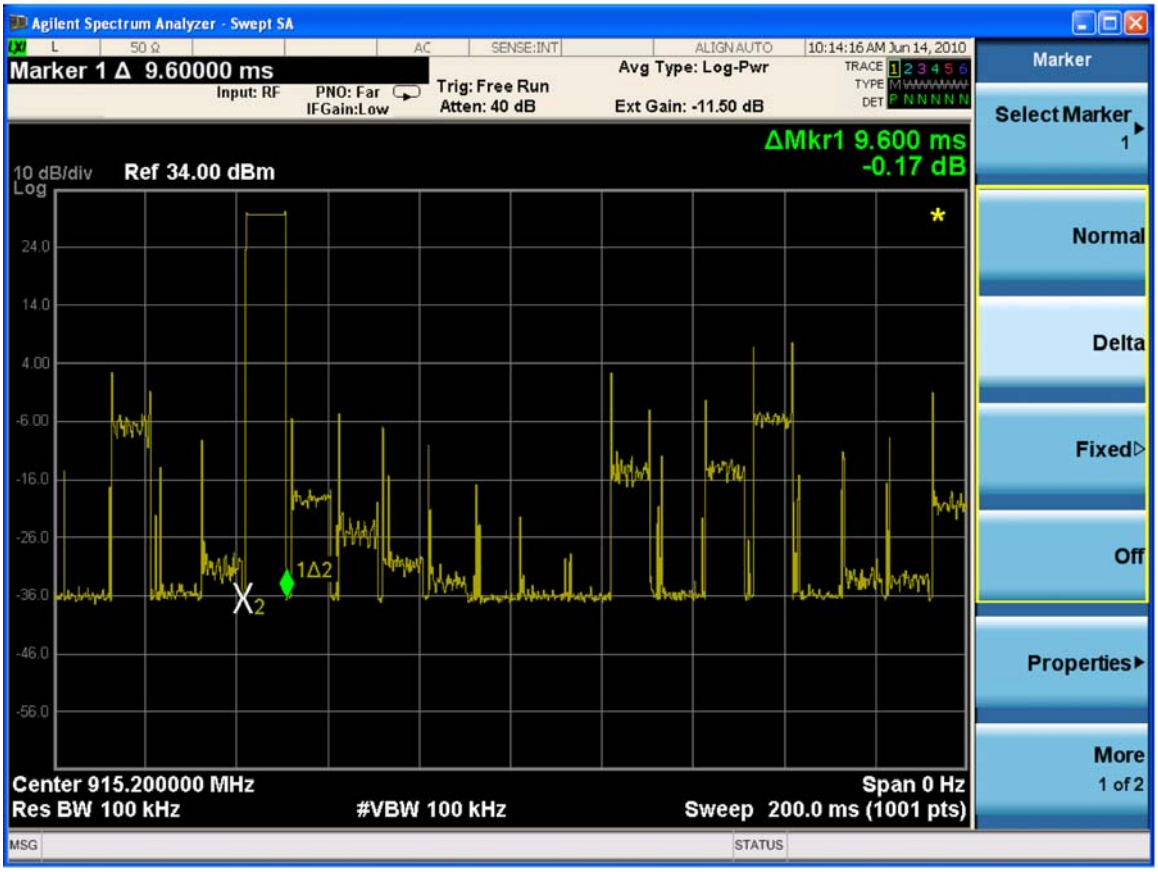
RESULTS

No non-compliance noted:

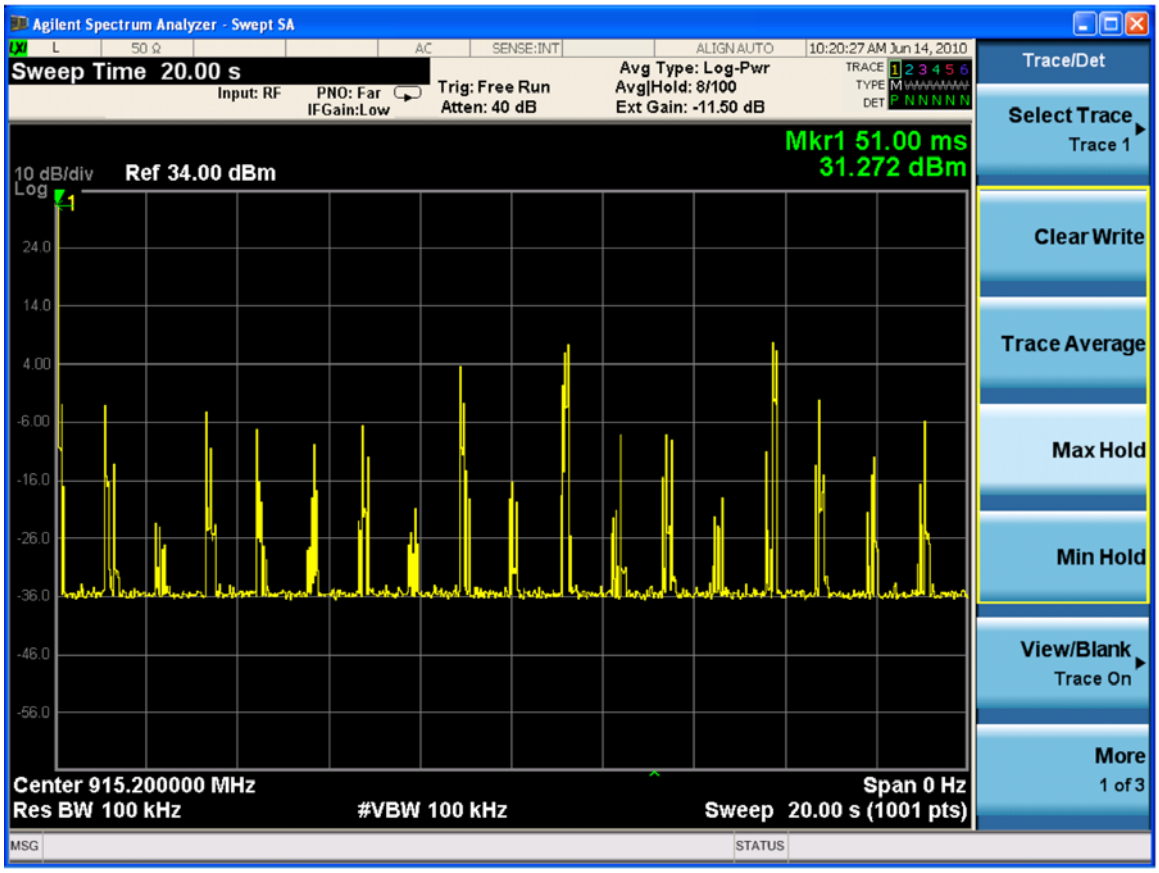
There is1 pulse within the 20-second period. The on time for each pulse is 9.6 msec.

Therefore, the average time of occupancy in the specified 20-second period is 9.6msec.

PULSE WIDTH


Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 9.60000 ms
Input: RF
PNO: Far
IFGain:Low
Trig: Free Run
Atten: 40 dB
Avg Type: Log-Pwr
Ext Gain: -11.50 dB
10:14:16 AM Jun 14, 2010
ΔMkr1 9.600 ms
-0.17 dB
10 dB/div
Log
Ref 34.00 dBm
24.0
14.0
4.00
-6.00
-16.0
-26.0
-36.0
-46.0
-56.0
1Δ2
Center 915.200000 MHz
Res BW 100 kHz
#VBW 100 kHz
Span 0 Hz
Sweep 200.0 ms (1001 pts)
Marker
Select Marker
1
Normal
Delta
Fixed
Off
Properties
More
1 of 2
MSG
STATUS

NUMBER OF PULSES IN 20 SECOND OBSERVATION PERIOD



PEAK OUTPUT POWER

FCC: 15.247(b)2
RSS-210 A8.4(1)

The maximum antenna gain is 3 dBi, the number of hopping channels is over 50, therefore the power limit is 30 dBm.

TEST PROCEDURE

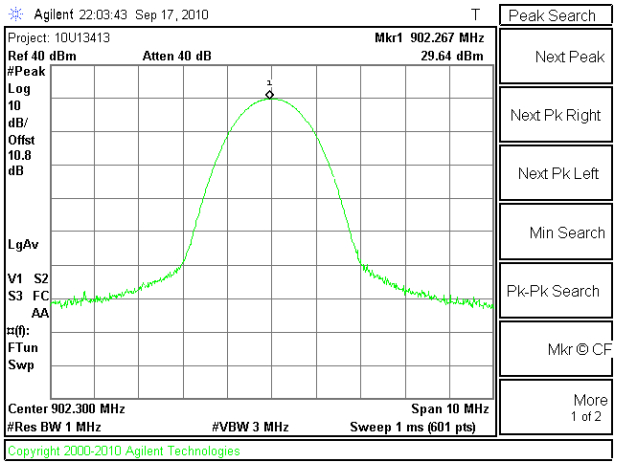
The transmitter output is connected to a spectrum analyzer and the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

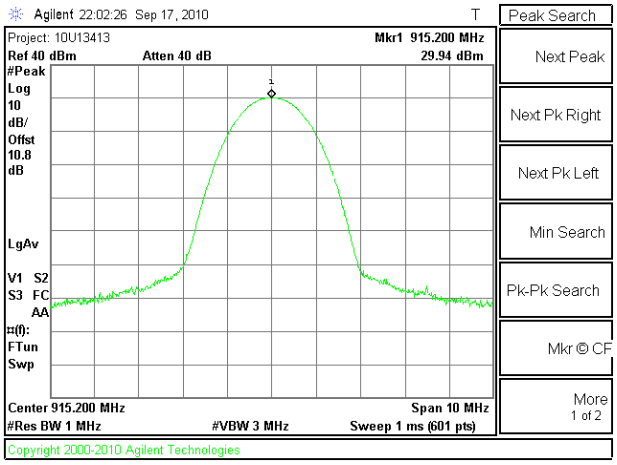
No non-compliance noted:

Channel	Frequency	P out, dBm	Pout, watts
Low	902.3	29.64	0.920
Mid	915.2	29.94	0.986
High	926.9	29.48	0.887

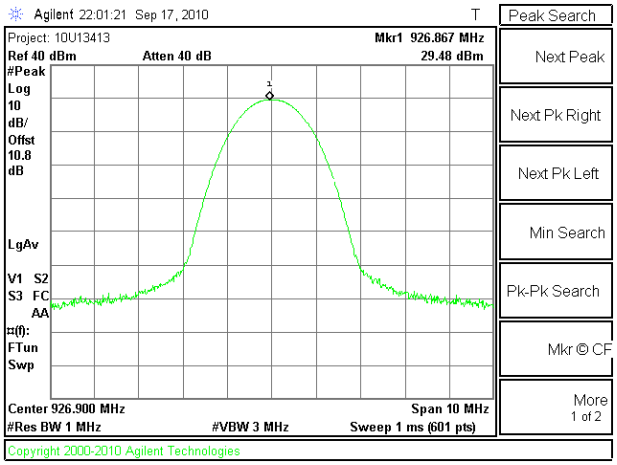
OUTPUT POWER LOW CHANNEL



OUTPUT POWER MID CHANNEL



OUTPUT POWER HIGH CHANNEL



MAXIMUM PERMISSIBLE EXPOSURE

FCC: 1.1310
IC: RSS-102

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

$S = E \wedge 2 / 3770$

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

$d = 0.282 * 10 \wedge ((P + G) / 20) / \sqrt{S}$ 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 = 0.6 mW/cm^2

RESULTS

No non-compliance noted:

Power Density Limit (mW/cm^2)	Output Power (dBm)	Antenna Gain (dBi)	S, mW/cm2 at 20cm
0.6	29.94	3.00	0.39

MPE Distance: 16.15 cm

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

FCC: 15.247 (c)
IC: RSS 210 A8.5

TEST PROCEDURE

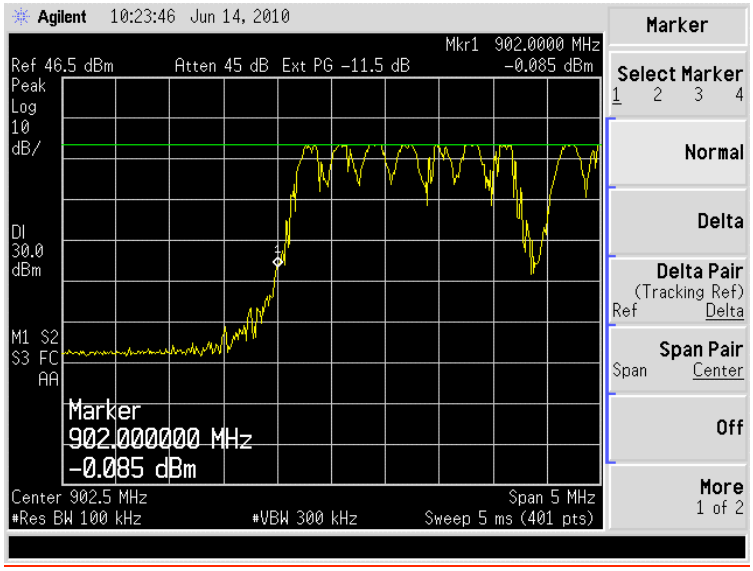
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

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

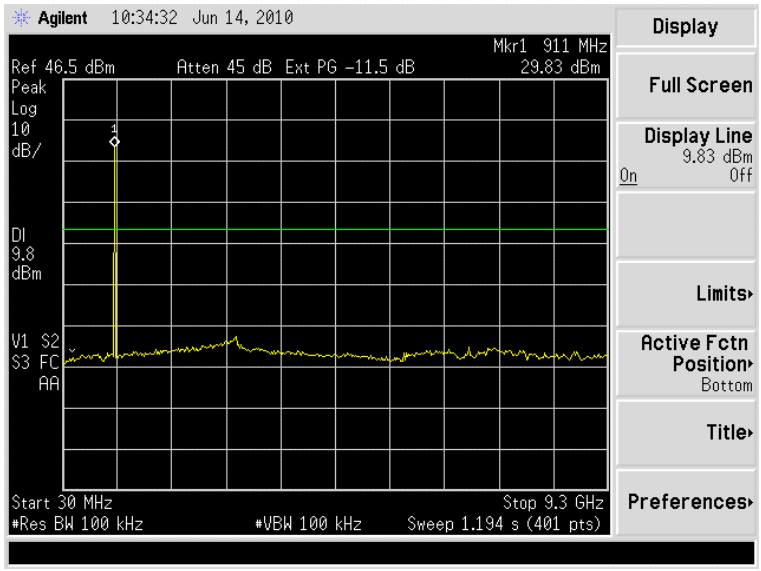
RESULTS

No non-compliance noted:

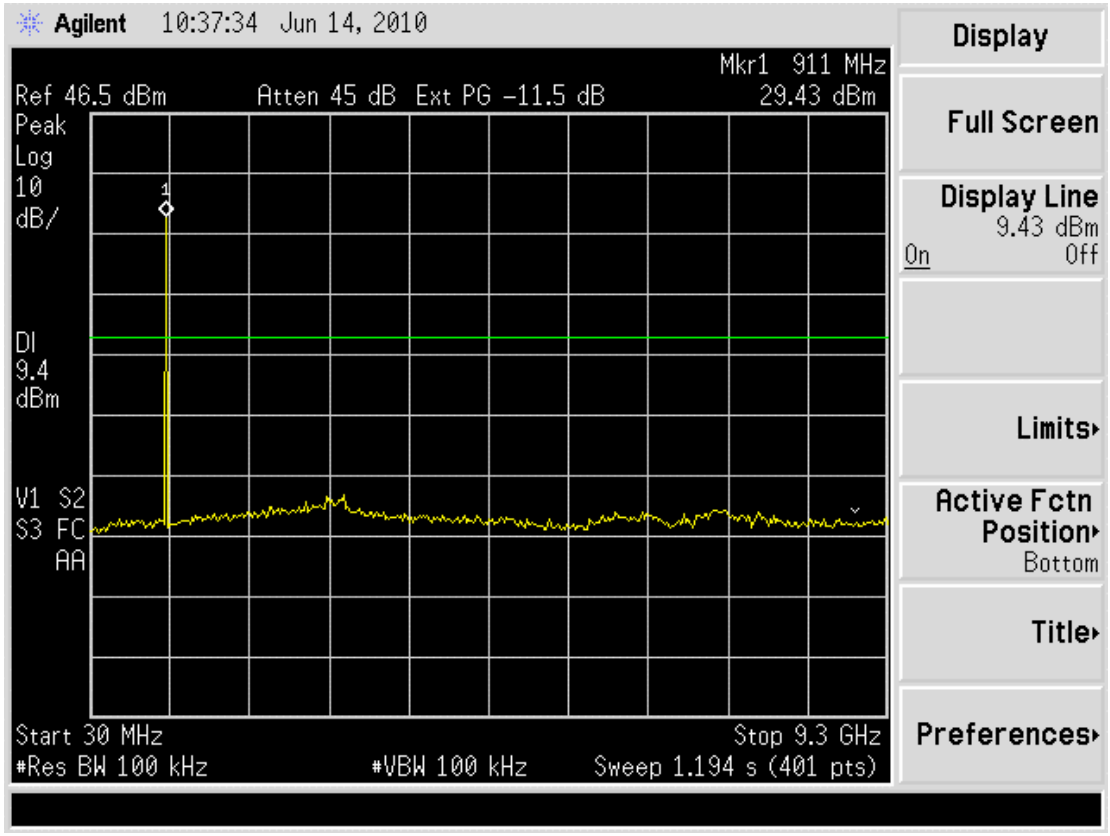
SPURIOUS EMISSIONS, LOW CHANNEL, HOPPING



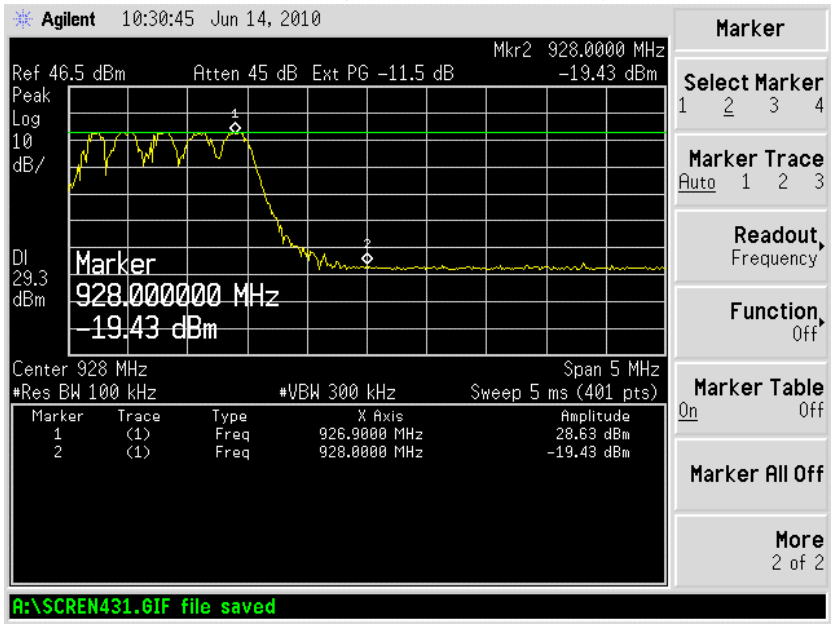
SPURIOUS EMISSIONS, LOW CHANNEL



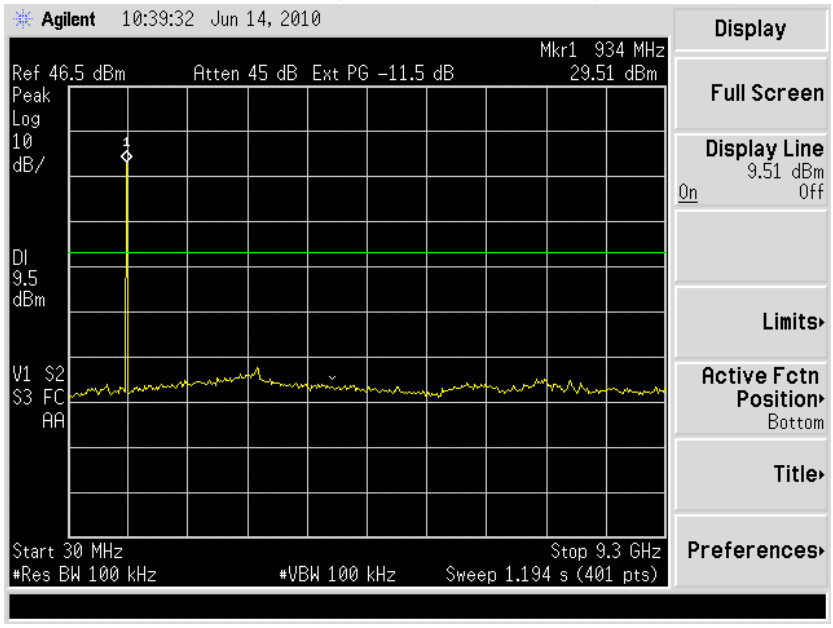
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL, BANDEDGE



SPURIOUS EMISSIONS, HIGH CHANNEL, HOPPING



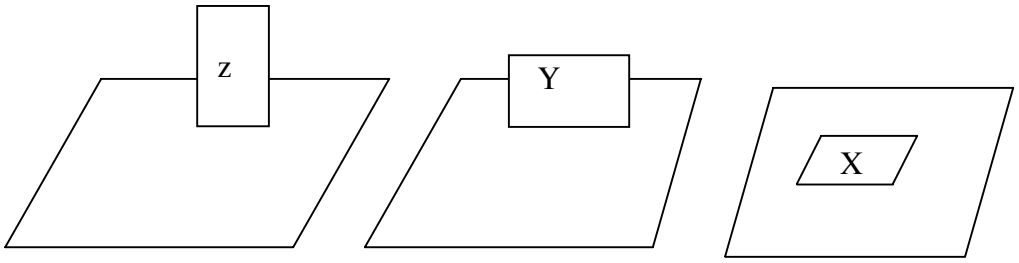
4.4 POWERLINE CONDUCTED EMISSIONS

LIMIT

FCC: 15.207
IC: RSS-Gen Sec. 7.2.4

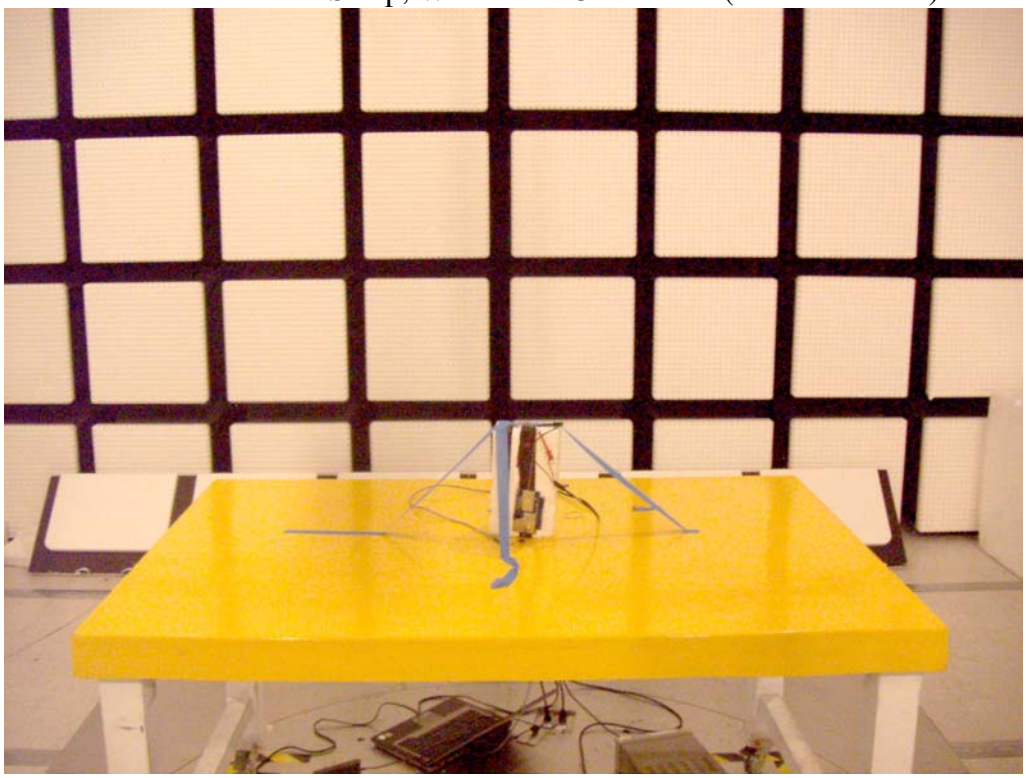
TEST NOT REQUIRED. EUT is battery powered only.

RADIATED RF MEASUREMENT SETUP

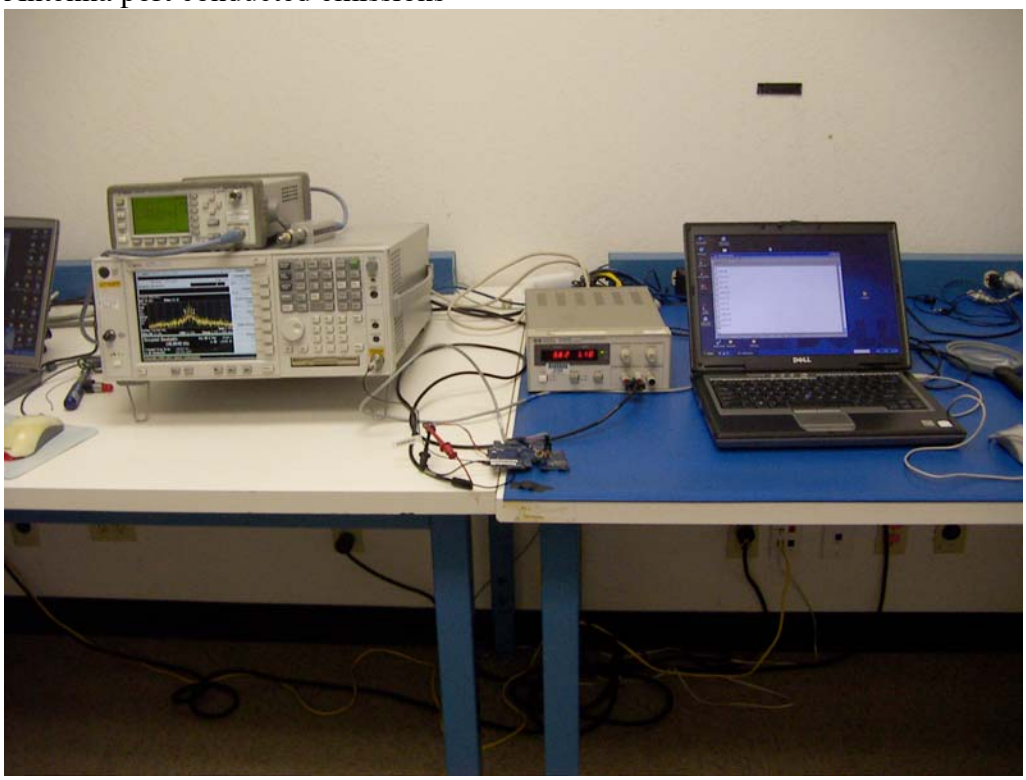


SETUP PHOTOS

Radiated Emissions Test Setup, Worst-case Orientation ("Z" orientation)



Antenna port conducted emissions



END OF REPORT

Report Revision History

Revision No.	Revision Description	Pages Revised	Revised by	Date
-	Original Issue		T. Cokenias	4/17/2011
	Add Quasi-Peak reading	8	T. Cokenias	5/2/2011