



FCC Part 15.247 Certification Application

**Industrie Canada RSS210 Certification
Application**

**EMI Test Report
on
Silverspring Networks FSU
Model:210-910001**

FCC ID: OWS-NIC504

IC ID: 5975A-NIC504

Report SSN06

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General Information

Unit(s) Under Test: FSU (Field Service Unit)
Model(s): 210-910001

Product Description: "Field Service Unit"

FCC ID: OWS-NIC504
IC ID: 5975A-NIC504

Tested For: Silver Spring Networks
2755 Campus Drive
Suite 205
San Mateo, CA 94403

Tested At: (Radiated Emissions)
Elliott Laboratories
41039 Boyce Road
Fremont, CA

(RF Conducted tests)
Elliott Laboratories
41039 Boyce Road
Fremont, CA 94538

Tested By: Rafael Veralas, Test Engineer, Elliott Labs
David Waitt, (Independent Consultant)

Tested To: FCC CFR 47, Part 15.247, 900MHz FHSS

Test Date: 27 July 2007

Requested Certifications: FCC Part 15 Subpart C certification
IC RSS-210 / Issue 6 Certification

Detailed Product Information

The FSU is a 900MHz FHSS radio that Silverspring intends to provide to field service personal to allow wireless interrogation of Silverspring wireless utility power meters.

Number of hopping channels:	83
Operating Frequency Range:	902.3 MHz to 924.9 MHz
Channel spacing:	300kHz
RF Power Output:	4.25 dBm
Antenna Gain:	0.8 dBi
Antenna Type:	Single, Integral, monopole
Operating Voltage:	Powered from a standard USB connection
DUT:	Engineering prototype, equivalent to mass produced items
Modifications:	No modifications were made to the unit during testing

Test Results Summary

This report presents the results of the tests that verify compliance with FCC Part 15.247 and RSS210

A brief results summary of all the in this report is below.

Part 15 Paragraph	RSS-210, Issue 6 Paragraph	Test	Results
15.247(b)(2)	A8.4(1)	Maximum Power	4.25 dBm Max
15.247(a)(1)(i)	A8.1(3)	20dB Bandwidth	157.5 kHz Max
15.247(d) 15.205	A8.5 2.6	Out of Band Spurious Emissions Radiated Emissions in Restricted bands	1.3dB in spec min @ 7415.16MHz (Restricted
Band)			
15.247(a)(1)(i)	A8.1(2)	Number of hopping channels	83
15.247(a)(1)(i)	A8.1(2)	Channel Spacing	300kHz

Test Facilities

All radiated emissions testing for 15.247 (15.205) were performed at:

Elliott Laboratories
41039 Boyce Road
Fremont, CA 94538

Testing was conducted in accordance with ANSI C63.4 (2003)

General:

Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data for chamber 1 has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Within the chamber, ambient levels are well below this requirement. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

Antenna, Antenna Mast and Turntable

The Horn antennas that are use to measure radiated emissions above 1000MHz are amounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

ANSI C63.4 specifies that the test height above the ground plane shall be 80cm unless the equipment is intended to be floor mounted. During the radiated emissions tests the equipment is positioned on a motorized turntable in conformance with the most recent ANSI requirements.

Equipment Lists

Instrument Calibration

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles.

The following test equipment was used to perform the testing

Elliott Test Equipment

Radiated Emissions, 30 - 10,000 MHz, 16 Aug-07				
Engineer: Rafael Veralas				
<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Hewlett Packard	Microwave Preamp, 1-26.5GHz	8449B	263	16-Mar-08
EMCO	Antenna, Horn, 1-18 GHz	3115	786	28-Nov-07
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	11-Jan-08
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	03-May-08
Hewlett Packard	High Pass filter, 1.5 GHz (Purple System)	P/N 84300-80037 (84125C)	1769	08-Nov-07
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	1771	11-Nov-07

Conducted Emissions - AC Power Ports, 16 Aug-07				
Engineer: Rafael Veralas				
<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Elliott Laboratories	LISN, FCC / CISPR	LISN-3, OATS	304	18-Jul-08
Solar Electronics	LISN	8028-50-TS-24-BNC support	904	19-Jan-08
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	21-Nov-07
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	1398	05-Feb-08

Celltech Power Meter nused for power out measurement

Conducted Emissions - RF Output power				
Engineer: Sean Johnstone				
<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Gigatronics	8652A Power Meter Serial # 1835272	8652A	# 00007	26 Mar 08

Test Methods

Unless otherwise noted in the specific test procedure, tests are performed at a low, middle and high channel band used by the device. Unless otherwise noted, all testing was performed on these channels / frequencies.

902 - 928 MHz Band	
Channel	Freq(MHz)
Low	902.3
Mid	915.4
High	926.9

The device was running special diagnostic software to allow it to transmit random data on a particular channel indefinitely. This diagnostic software allowed the frequency hopping function to be disabled or enabled as tested required.

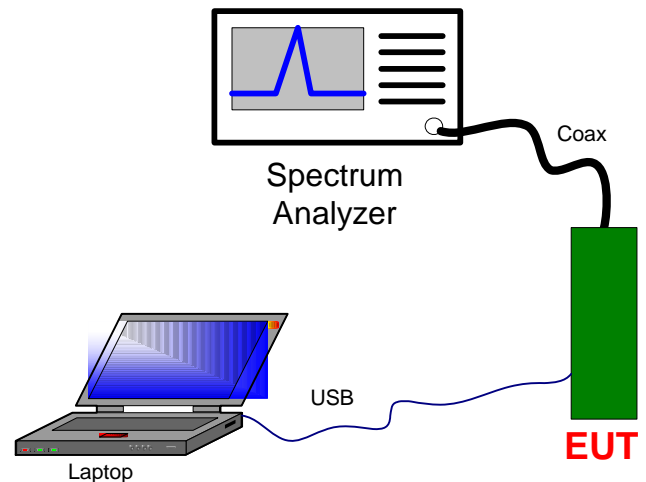
The diagnostic software also allowed variation of the RF transmit power. The maximum power setting that allowed compliance with the radiated emissions requirements (determined during testing) will be programmed into the configuration firmware of the module. This will ensure compliance with the FCC / IC radiated emissions requirements.

The tests listed below are performed using the basic “conducted” test setup shown below unless otherwise noted

Part 15	Test
15.247(b)(2)	RF Transmit power
15.247(a)(1)(i)	Bandwidth
15.247(a)(1)(i)	Number of hopping channels
15.247(a)(1)	Channel Spacing
15.247(a)(1)(i)	Time on channel

Basic Conducted RF Bench Test Setup

The bench top RF test setup is shown to the right. Unless otherwise noted, the support equipment for the bench tests is listed below.



Support Equipment				
Description	Model number	FCC ID or SN	Manufacturer	Power Cable
Laptop	Satellite	DOC	Toshiba	Laptop PS, unshielded

Test Results

Detailed test procedures and test results are contained in the following sections. In cases where the test setup differs from the “Conducted RF Bench Top” test setup shown earlier, the test setup is also presented within that section of the test report.

Test Conditions			
Temperature	23C	Humidity:	Approx 55%
ATM pressure	1020 mBar	Grounding:	None
Tested By	David Waitt	Date of Test:	2 July 2007
Test Reference	Refer to individual test results		
Tested Freq Range	Test dependent		
Test Voltage	120 VAC		
Modifications	No internal modifications were made t the unit during he conducted testing. Some modification were made during the radiated emissions testing.		

Maximum RF Power Output at Antenna Terminals

Specifications:

FCC Specification: Paragraph: 15.247(b)(2)

IC Specification: RSS-210/6, A8.4(1)

Procedure:

The RF transmit power was measured with an AVG power meter. The unit was sequentially tuned to the test channels (Low, Mid and High) and configured to transmit random data (100% duty cycle).

Results:

Measured RF power levels are below.

	Power (dBm)	Power (mW)	(Max EIRP dBm) Peak antenna gain (0.8 dBi)
LOW	4.05	2.54	4.85
MID	3.99	2.51	4.79
HIGH	4.25	2.66	5.05

20 dB Bandwidth

Specifications

FCC Specification: Paragraph 15.247(a)(1)(i)

IC Specification: RSS-210 / 6 A8.1(3)

Procedure:

The 20 dB bandwidth was measured on the low middle and high channels of the 900 MHz band using the conducted RF test setup. The spectrum analyzer was configured for MAX HOLD and the trace allowed to stabilize. A peak search was performed and the then “Delta-Marker” used to locate the points at –20dB below the peak.

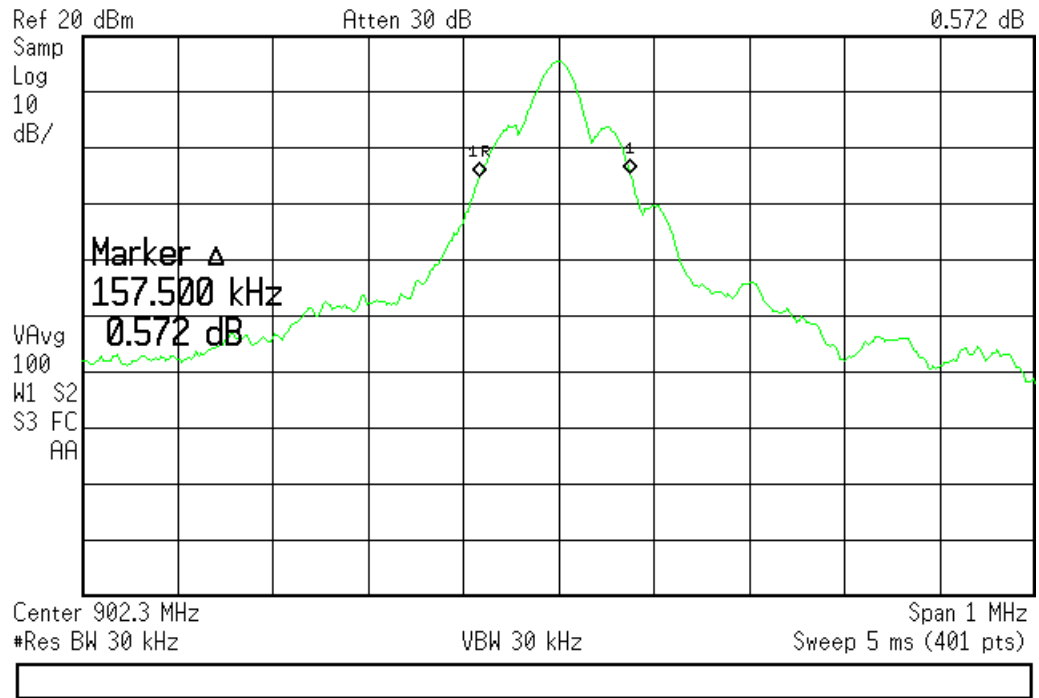
The bandwidth test was performed at the power settings that will be used in the final system.

Results:

	20 dB BW (kHz)	Spec (kHz)	Delta (kHz)
LOW	157.5	500	342.5
MID	152.5	500	347.5
HIGH	147.5	500	352.5

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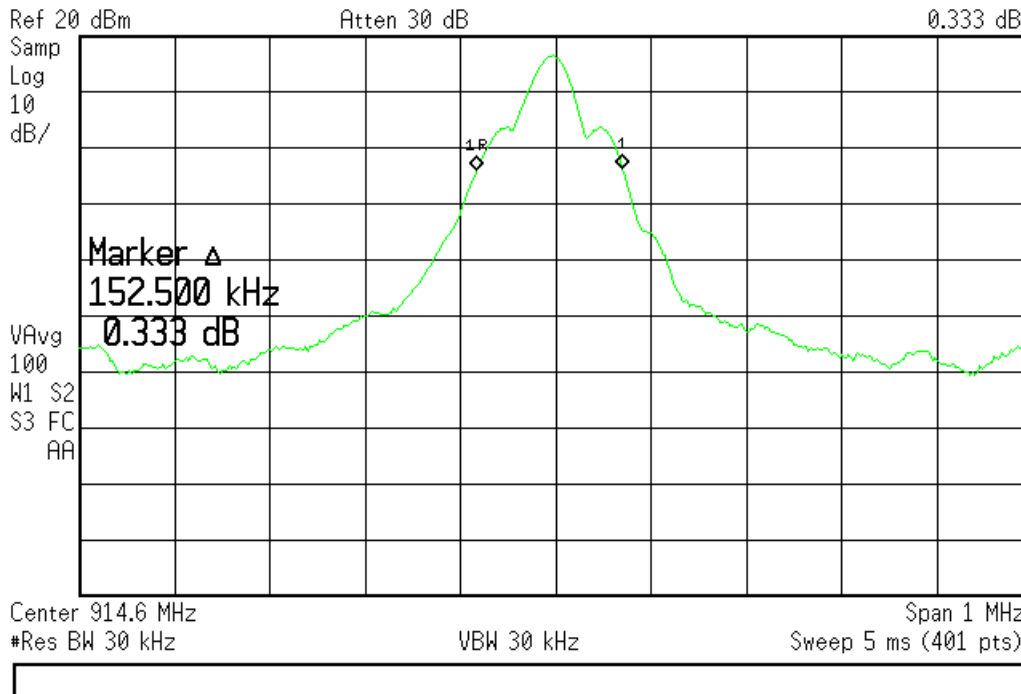
Mkr1 Δ 157.5 kHz
0.572 dB



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Mkr1 Δ 152.5 kHz
0.333 dB

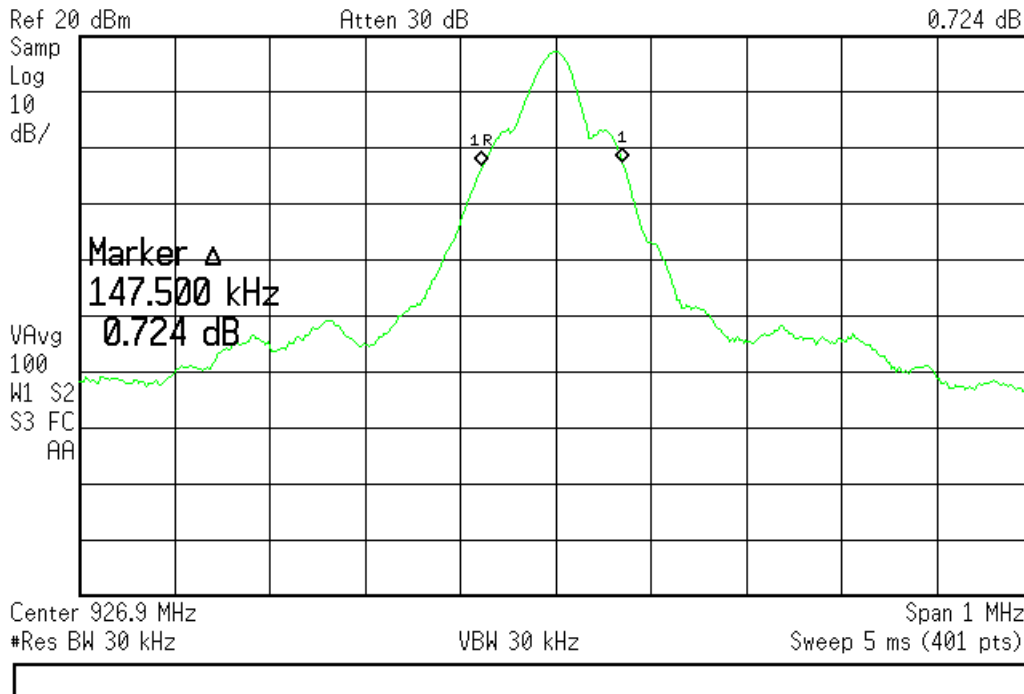
20 dB BW, MID Channel



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Mkr1 Δ 147.5 kHz
0.724 dB

20 dB BW, HIGH channel_



900MHz Band Edge

Specifications:

FCC Specification: Paragraph 15.247(d)

IC Specification: RSS-210/6 A8.5

Procedure:

The test setup was configured as shown in the conducted test setup. The UUT was configured to continuously transmit random data on the low, and then the high test channel. The span of the analyzer was centered on the 902 and 928 MHz band edge respectively.

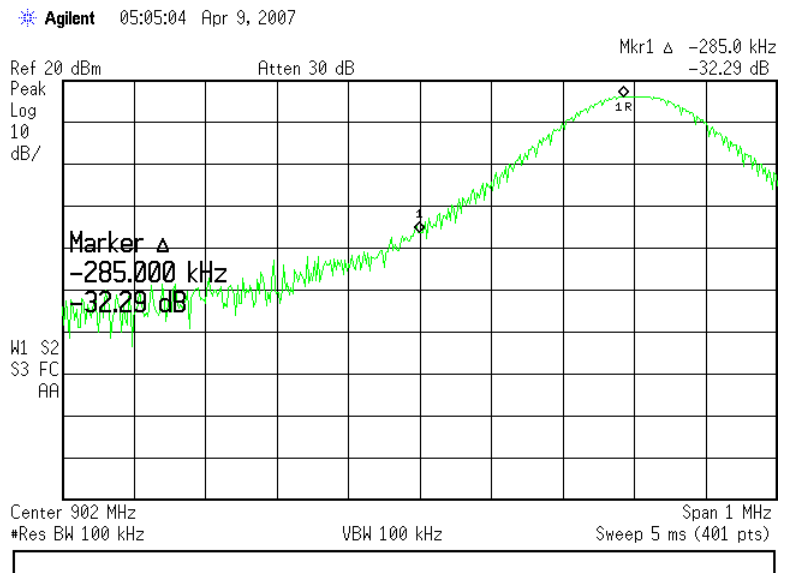
The RBW & VBW were set to 100 kHz. The trace was allowed to stabilize then a Peak-search and a marker delta measurement to the band edge was performed to verify that the RF power at the band edge was at least 20 dB below the peak of the fundamental level.

Results:

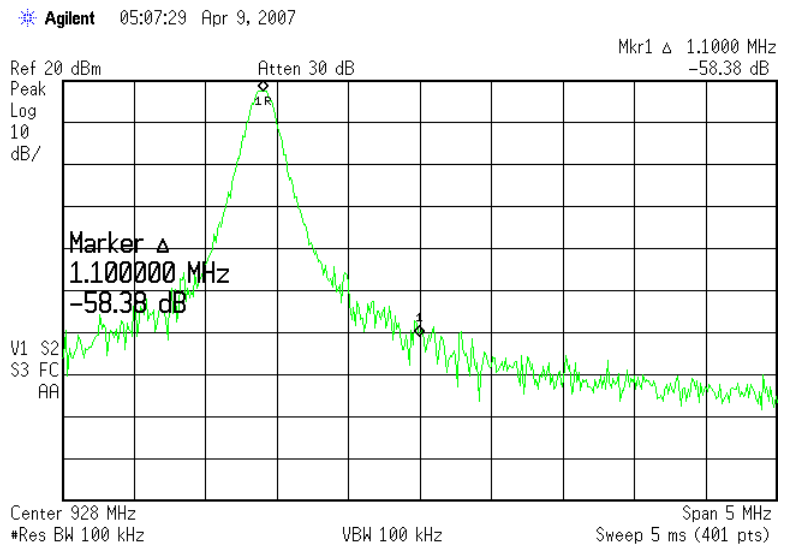
Level at 902 MHz: -32.29dBc Spec -20 dBc Min

Level at 928 MHz: -58.38dBc Spec -20 dBc Min

902 MHz Bandedge



928 MHz Bandedge



Radiated Emissions in Restricted Bands & Out of Band Radiated Emissions

Specifications:

FCC Specification: Paragraph 15.247(d)

IC Specification: RSS-210 / 6 Sec 2.6

Procedure:

This test was conducted inside a semi-anechoic chamber at BACL. The unit was placed on a rotating wooden table 80cm above the ground plane. A Horn antenna was secured to a mast 3 meter away. The unit was tested at each of the Low, Mid and High channels. The UUT was running in the diagnostic mode and set to transmit at maximum on each of the channels in turn. The test equipment was configured as shown below.

The EUT was rotated 360 degrees and the height of the antenna adjusted from 1 to 4 meters above the ground plane to determine the maximum level of the emission. The level of the harmonic emission was measured in two modes, "Peak" and "Average".

The spectrum analyzer reading made by the test software and the appropriate correction factors (antenna factor, cable loss,...) were then applied by the test lab software to obtain a final corrected measurement.

Preliminary emission scans were performed on the EUT in three orthogonal planes. It was determined that the horizontal plane was the worst case. The final radiated emissions data was recorded with the EUT being vertical. (as shown below)



Axis 2 positioning



Axis 3 positioning



Axis 1 Positioning, This was determined to be the worst case positioning. This is the axis used for obtaining the final data

The data presented below was taken with the unit in the worst case position (vertical). This procedure was performed for all of the channels outlined in the Test Methods section of this report.

The band up to 10 GHz was examined. The table below indicates the harmonics that fall within restricted bands. **RED** indicates a harmonic that falls within a restricted band and is subject to 15.205. The harmonics in **Green** are NOT in restricted bands and are subject to 15.209

CHAN	FUND	2	3	4	5	6	7	8	9	10
LOW	902.3	1804.6	2706.9	3609.2	4511.5	5413.8	6316.1	7218.4	8120.7	9023.0
MID	915.4	1830.8	2746.2	3661.6	4577.0	5492.4	6407.8	7323.2	8238.6	9154.0
HIGH	926.7	1853.4	2780.1	3706.8	4633.5	5560.2	6486.9	7413.6	8340.3	9267.0

15.205 Harmonic test tables

Radiated Emissions in Restricted Bands Test conditions / Setup

Support Equipment			
Description	Model number	FCC ID or SN	Manufacturer
Laptop	Satellite	DOC	Toshiba
Power Cable	Laptop PS, unshielded		

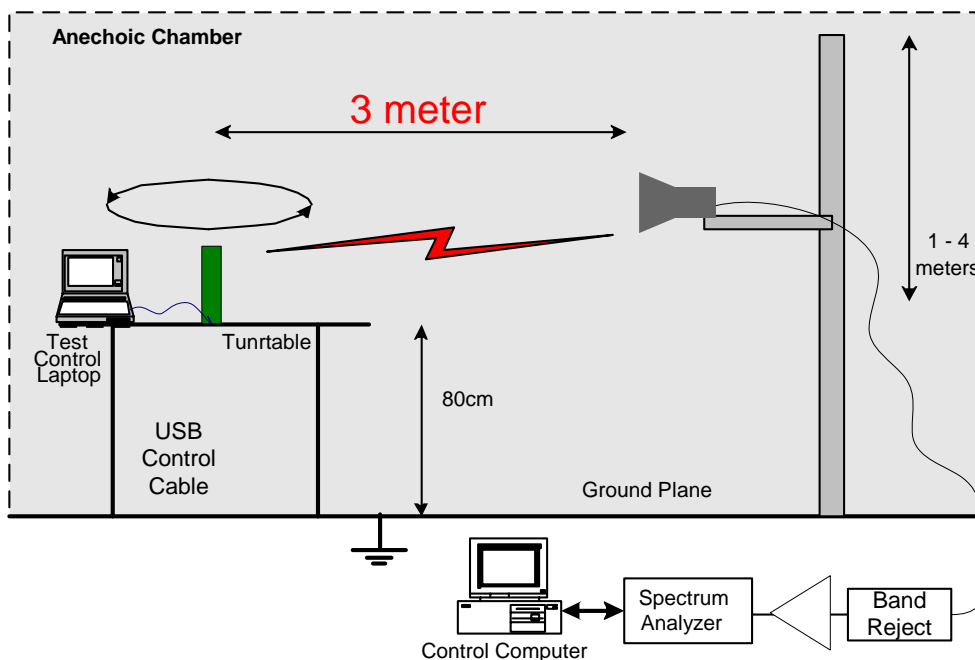
Test Conditions			
Temperature	24 C	Humidity:	73%
ATM pressure	29.72 in	Grounding:	None
Tested By	Rafeal Veralas, Elliott	Date of Test:	July 2007
Test Reference	FCC Part 15.205 IC Paragraph RSS210, 6.2.3 (c)		
Setup Method	ANSI C63.4		
Tested Range	1 GHz to 10GHz		
Test Voltage	3.6 VDC		
Modifications	No modifications were made to the unit		

NOTES: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

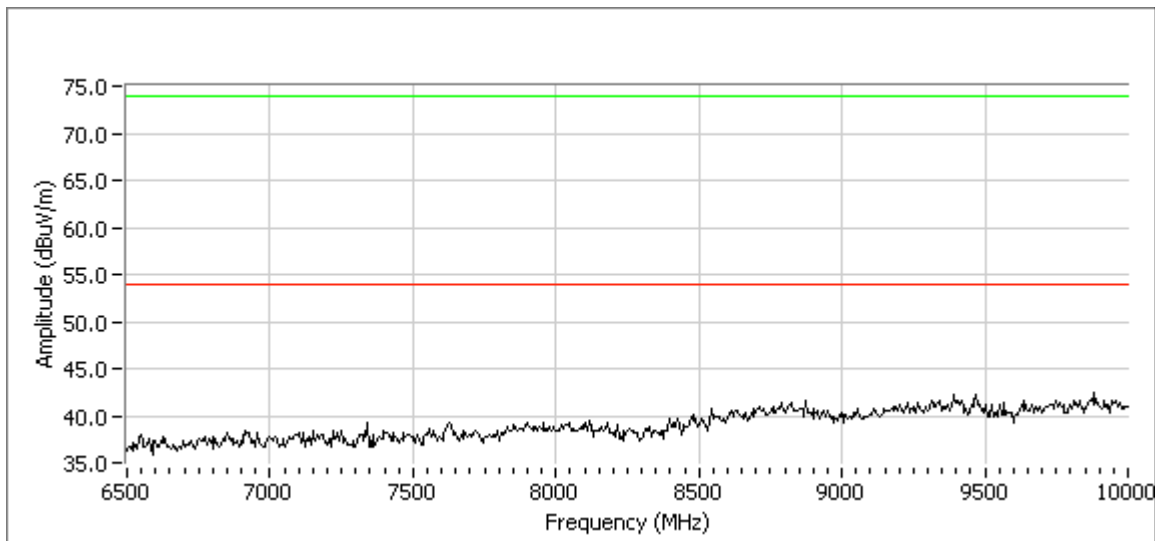
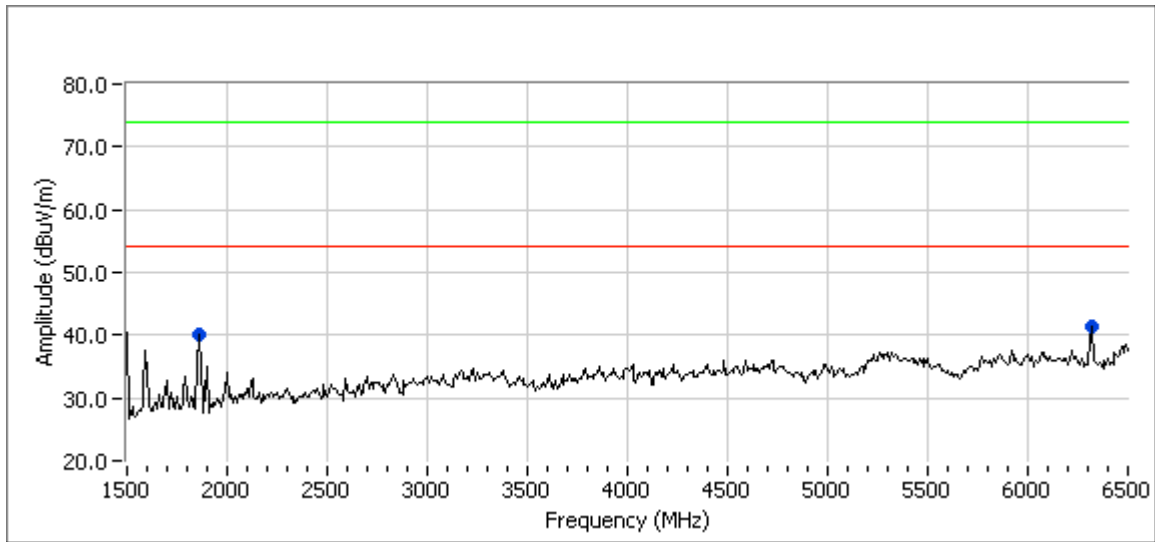
Restricted Band Peak Measurements: RBW = VBW = 1 MHz

Restricted Band Average Measurements: RBW =1MHz and VBW=10 Hz.

All other measurements, RBW = 1MHz and VBW = 3MHz, video averaging on (100 samples).

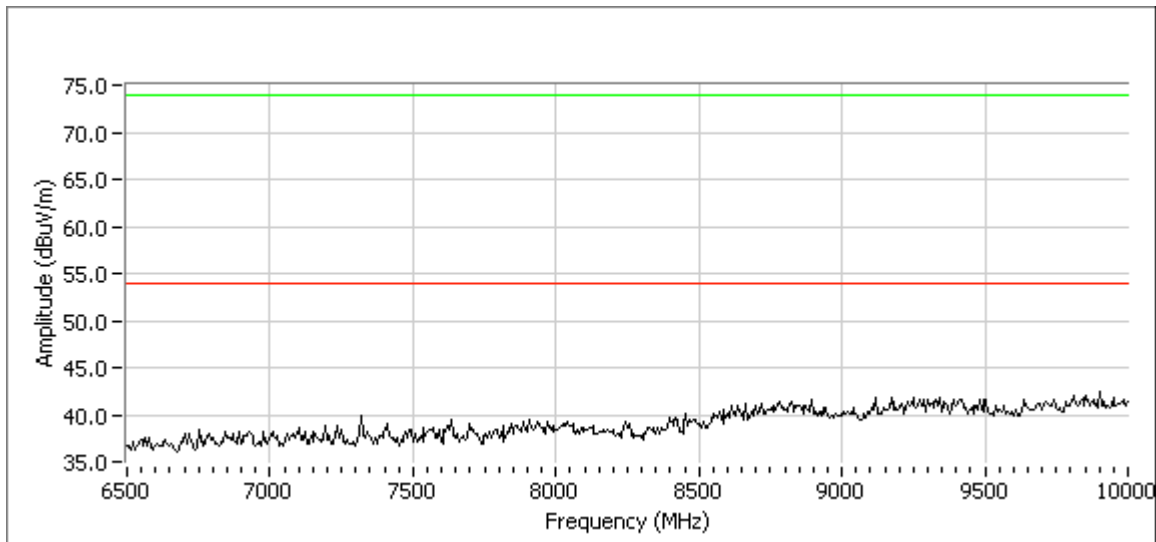
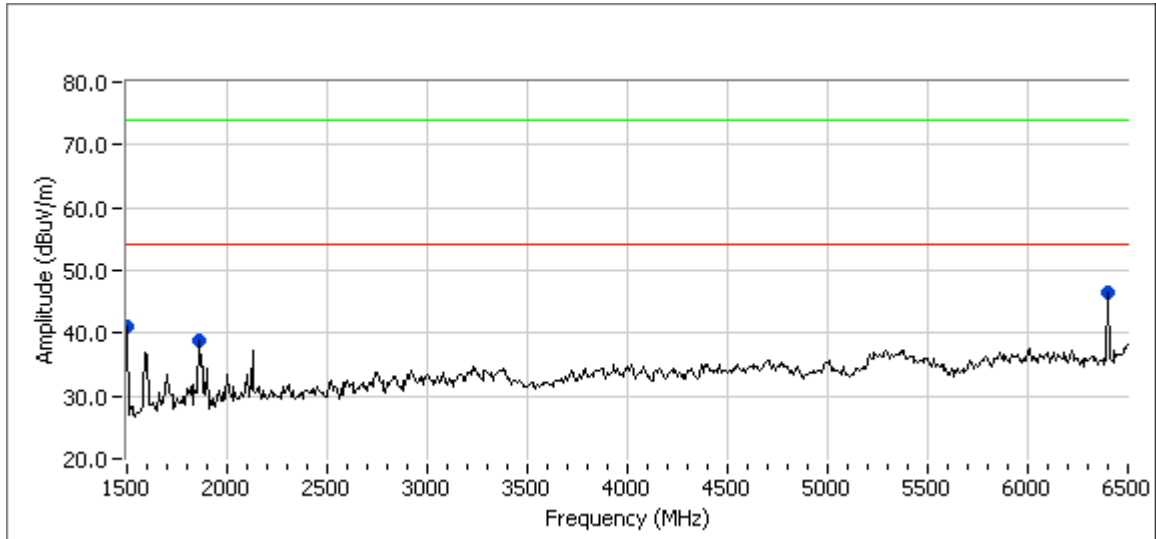


Results:
EUT Transmitting on LOW channel, 902.3 MHz



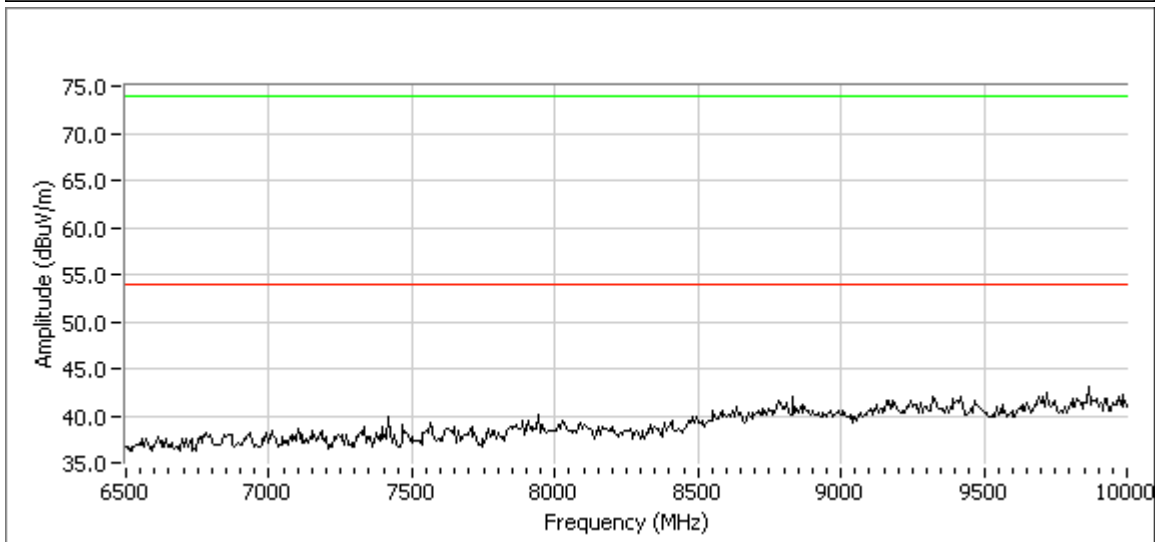
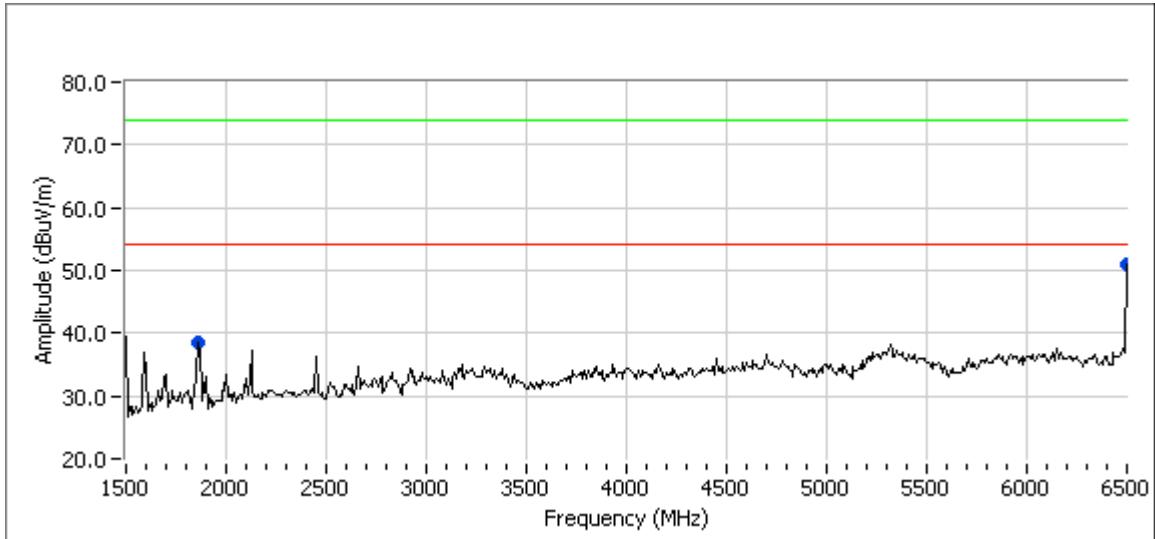
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1806.520	24.8	V	54.0	-29.2	AVG	60	1.0	Non Restricted
1806.520	41.1	V	74.0	-32.9	PK	60	1.0	Non Restricted
6316.000	38.2	V	54.0	-15.8	AVG	67	1.0	Non Restricted
6316.000	45.3	V	74.0	-28.7	PK	67	1.0	Non Restricted

EUT Transmitting on MID channel, 914.6 MHz



Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
1828.260	23.8	V	54.0	-30.2	AVG	66	1.0	Non Restrictcd
1828.260	39.4	V	74.0	-34.6	PK	66	1.0	Non Restrictcd
1830.000	22.2	H	54.0	-31.8	AVG	66	1.0	Non Restrictcd
1830.000	33.4	H	74.0	-40.6	PK	66	1.0	Non Restrictcd
6402.130	41.3	V	54.0	-12.7	AVG	60	1.3	Non Restrictcd
6402.130	47.1	V	74.0	-26.9	PK	60	1.3	Non Restrictcd
6402.190	42.2	H	54.0	-11.8	AVG	106	1.1	Non Restrictcd
6402.190	47.6	H	74.0	-26.4	PK	106	1.1	Non Restrictcd

EUT Transmitting on HIGH channel, 926.9 MHz



Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1853.370	25.1	V	54.0	-28.9	AVG	61	1.0	Non Restricted
1853.370	42.6	V	74.0	-31.4	PK	61	1.0	Non Restricted
6488.300	48.9	V	54.0	-5.1	AVG	101	1.3	Non Restricted
6488.300	52.6	V	74.0	-21.4	PK	101	1.3	Non Restricted

Number of Hopping Channels

Specifications:

FCC Specification: Paragraph 15.247(a)(1)(i)

IC Specification: RSS-210 / 6 A8.1(2)

Procedure:

The test setup is as shown in the Conducted RF bench setup. The EUT was configured to hop sequentially through all of its channels. (This is not possible with the normal operating code). The spectrum analyzer was set to MAX HOLD to capture the number of hopping channels. The entire 902 - 928 MHz band was examined in three sub-bands. 902 - 910 MHz, 910 - 920MHz and 920 - 928 MHz. The results are below.

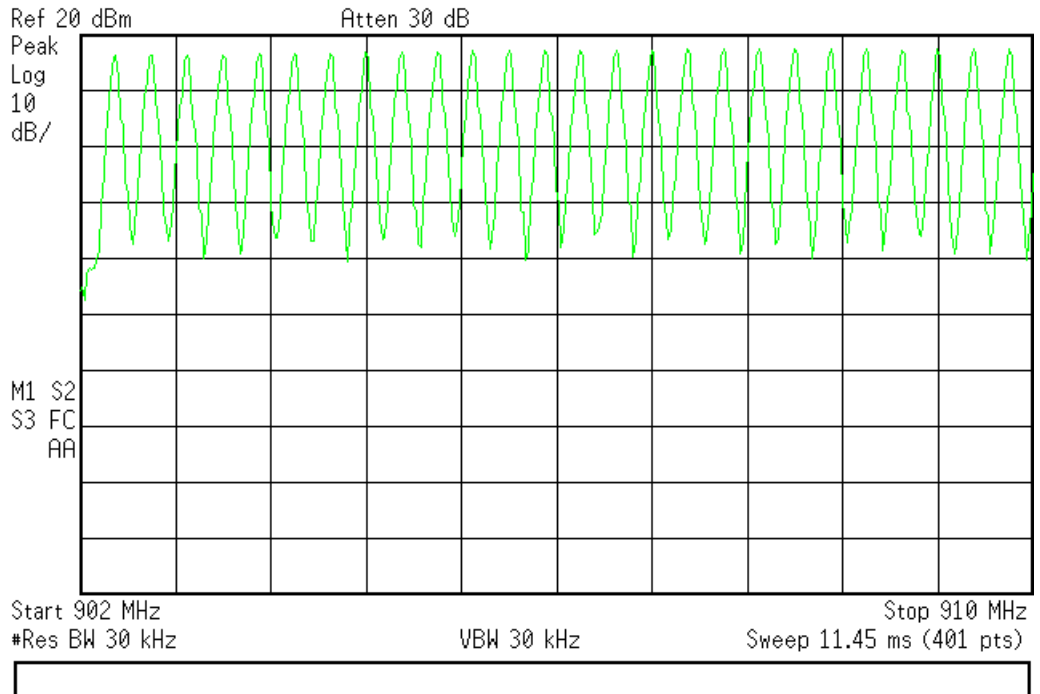
Results:

All 83 hopping channels were recorded.

From (MHz)	to (MHz)	Num of Channels
902	910	26
910	920	33
920	928	24
TOTAL		83

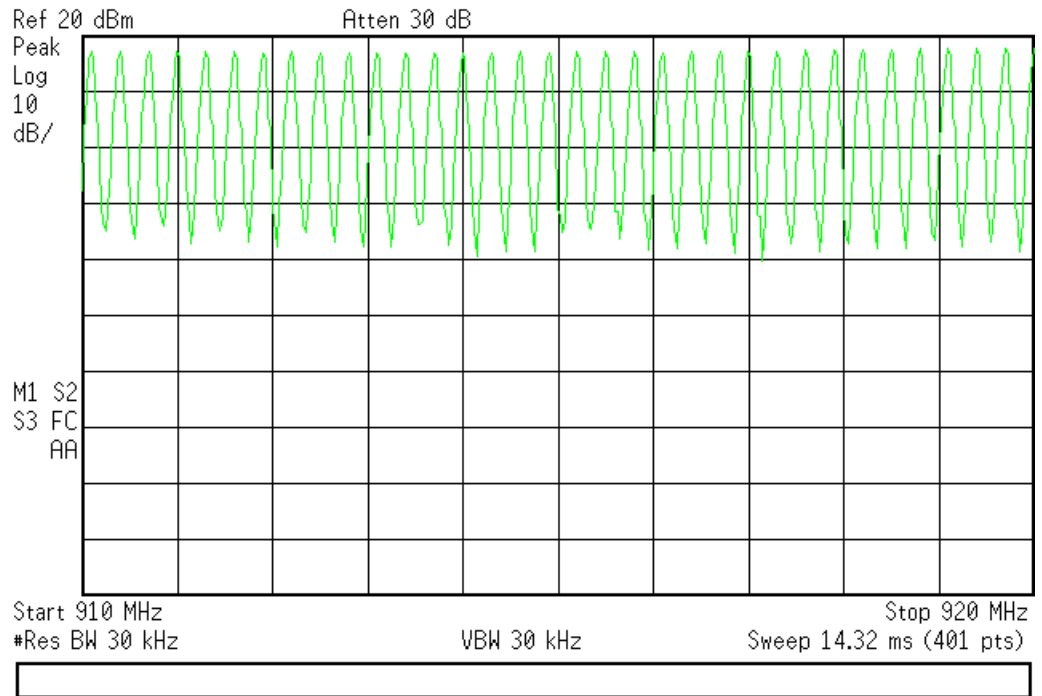
Agilent 05:21:34 Apr 9, 2007

902 - 910 MHz (26 Chan)



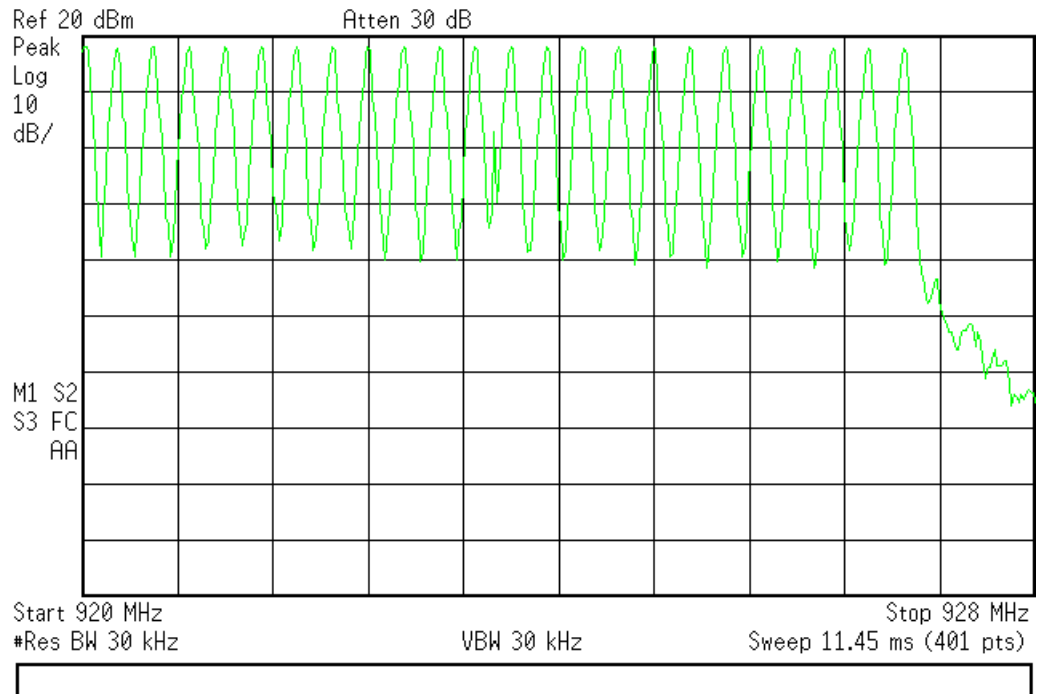
Agilent 05:22:42 Apr 9, 2007

910 - 920 MHz (33Chan)



Agilent 05:24:08 Apr 9, 2007

920 - 928 MHz (24Chan)



Channel Spacing

Specifications:

FCC Specification: Paragraph 15.247(a)(1)

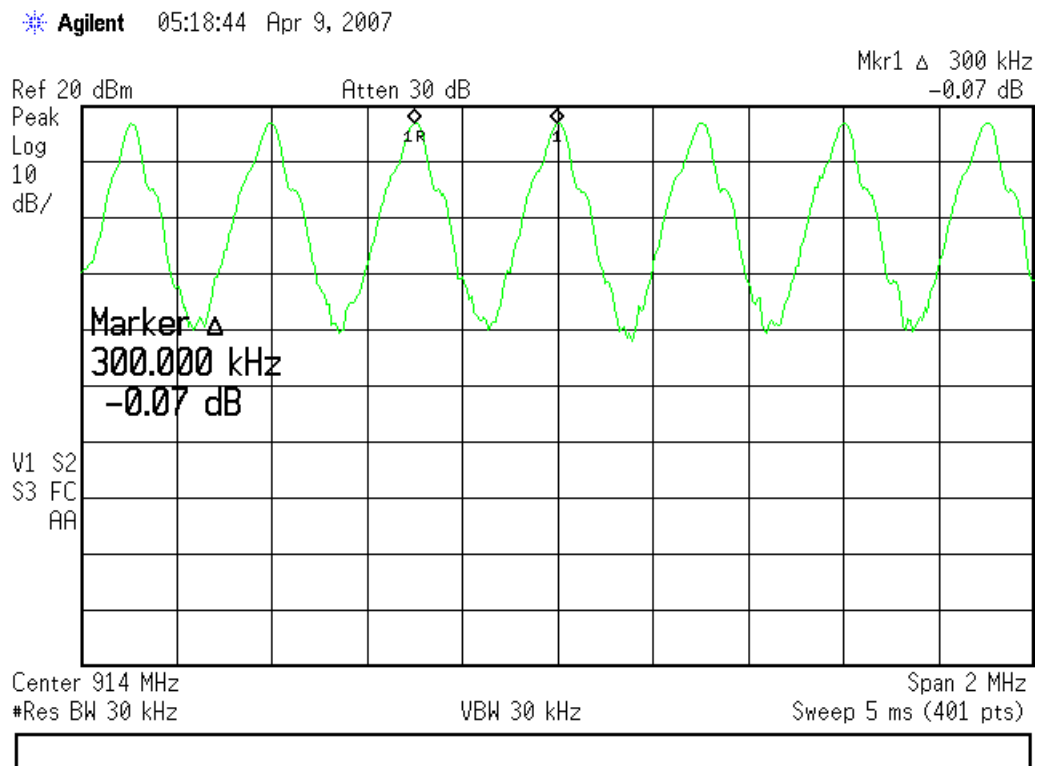
IC Specification: RSS-210 / 6 A8.1(2)

Procedure:

The test setup is as shown in the Conducted RF bench setup. The EUT was configured to hop sequentially through all of its channels. (This is not possible with the normal operating code). The spectrum analyzer was set to MAX HOLD to capture a few of the sequential channel frequencies. The spectrum analyzer markers were used to determine the channel spacing. The results are below.

Results:

Channel spacing was measured at **300kHz**. The specification requires that the channel spacing be greater than the measured 20 dB BW. The 20 dB BW was measured at a maximum of 157.5 kHz.



30MHz - 1 GHz Spurious Radiated Emissions

Specification:

FCC Specification: 15.109(f)

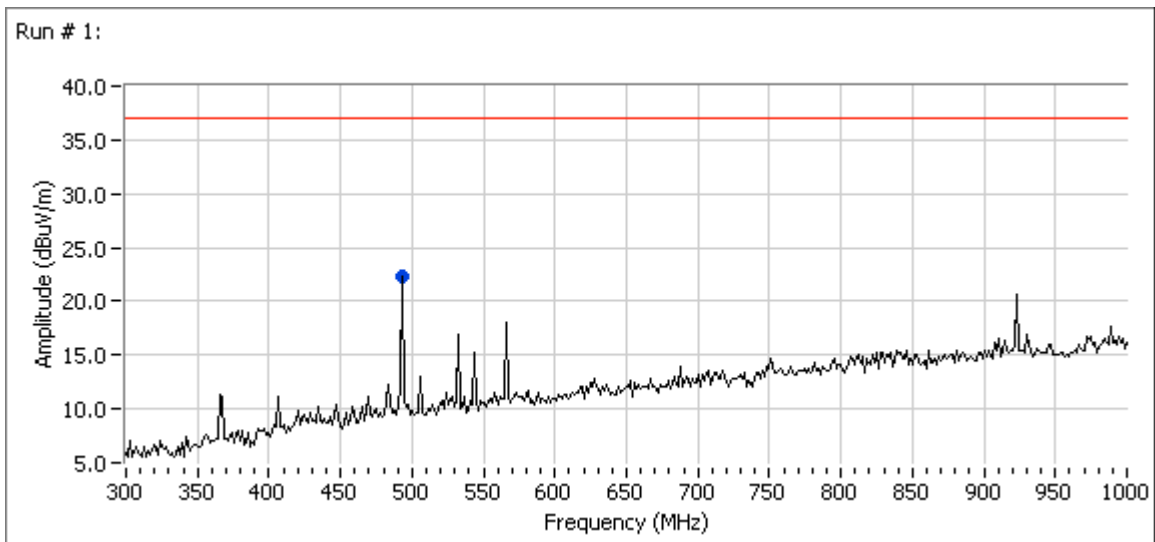
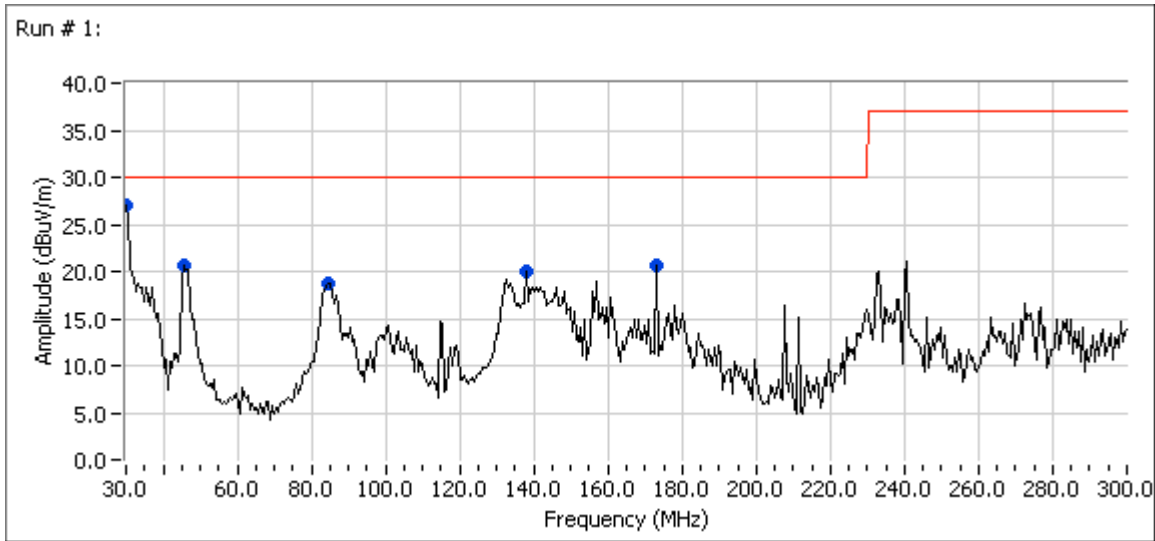
IC Specification: RSS210 / 6 A8.5

Procedure:

The test was configured as a standard ANSI C63.4 Class B radiated emissions test setup. The EUT was tested in both RCV and XMIT modes. The frequency range of 30 to 1000 MHz was scanned.

Results: (RCV mode)

The unit was set to receive only mode. Preliminary emissions were checked in all three orthogonal planes, the worst case results are presented. The unit was tested in Receive mode and transmit mode.



Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency MHz	Level dB μ V/m	Pol v/h	EN 55022 Class B		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
30.920	21.5	V	30.0	-8.5	QP	182	1.0	
167.814	21.0	V	30.0	-9.0	QP	189	1.0	
134.688	19.0	V	30.0	-11.0	QP	132	1.0	
46.156	18.5	V	30.0	-11.5	QP	0	1.0	
84.638	16.5	H	30.0	-13.5	QP	198	4.0	
491.595	20.0	V	37.0	-17.0	QP	206	1.0	