Emissions Test Report

EUT Name: Reader

EUT Model: R22-1012

FCC ID: URGR221012

CFR Title 47, FCC Part 15, Subpart C

Prepared for:

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Report/Issue Date: 6 February 2009
Report Number: 30862910.001 Rev. C

Statement of Compliance

Manufacturer:	RadarFind Corporation 2100 Gateway Centre Blvd., Suite 150 Morrisville, NC 27560 919 228-2170
Requester / Applicant:	Stephen Snell
Name of Equipment:	Reader
Operation Frequency Range	902.4 MHz to 927.6 MHz
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR Title 47, FCC Part 15, Subpart C
Test Dates:	05 January, 2009 to 08 January, 2009

Guidance Documents:

Emissions: FCC 47 CFR Part 15C

Test Methods:

Emissions: ANSI C63.4:2003

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that a sample of one, of the equipment described above, has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. This report contains data that are not covered by NVLAP accreditation. This report shall not be reproduced except in full, without the written authorization of the laboratory.

Mark Ryan

6 February 2009

NVLAP Signatory — Date

NVLAP 200094-0

FC 90552 and 100881

Industry Canada IC3755

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1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR Title 47, FCC Part 15, Subpart C based on the results of testing performed on *05 January*, 2009 through *08 January, 2009* on the *Reader* Model No. *R22-1012* manufactured by RadarFind Corporation. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 Summary of Test Results

Table 1 - Summary of Test Results

Test	Test Method(s)	Test Parameters	Measurement	Result
Channel Separation	FCC Part 15.247(a)(1)	Greater of 25 kHz or 20 dB bandwidth	283 kHz	**compliant**
Time of Occupancy	FCC Part 15.247(a)(1)(i)	=<0.4 sec in 10 sec.	0.124 sec in 10sec	**compliant**
Occupied Bandwidth	FCC Part 15.247(a)(1)(i)	=<500kHz	20dB = 274 kHz	**compliant**
Peak Output Power	FCC Part 15.247(b)(2)	0.25 Watts	0.0068 Watts	**compliant**
Spurious Emissions	FCC Part 15.247(c)	Table FCC Part 15.209	49.51 dBµV/m at 3 meters Average at 2718.0 MHz	**compliant**
Emissions outside the frequency bands	FCC part 15.247(d)	< 20dB at band edge	2.76MHz from band edge	**compliant**
Frequency Hopping Spread Spectrum Systems	FCC Part 15.247(g)			**compliant**
Incorporation of Intelligence	FCC Part 15.247(h)			**compliant**
Conducted Emissions	FCC Part 15.207(a)	Table FCC Part 15.207(a)		**compliant**

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

No modifications were found to be necessary in order to achieve compliance.

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90552 and 100881). The laboratory scope of accreditation includes: Title 47 CFR Part 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP

TUV Rheinland is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 25 and ISO 9002 (Lab code 200094-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada – Industry Canada

Registration No. IC3755

2.1.4 Japan - VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration No. R-1174 and C-1236).

2.1.5 Acceptance By Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address test results and test reports within the scope of the laboratory NIST / NVLAP accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 762 Park Ave., Youngsville, North Carolina 27596, USA.

2.2.1 Emission Test Facility

The Open Area Test Site and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2005, at a test distance of 3 and 10 meters. This site has been described in reports dated May 12, 1997, submitted to the FCC, and accepted by letter dated June 25, 1997 (31040/SIT 1300F2). The site is listed with the FCC and accredited by NVLAP (code 200094-0). The 5m semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2005, at a test distance of 3 meters. A report detailing this site can be obtained from TUV Rheinland.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7m x 3.7m x 3.175mm thick aluminum floor connected to PE ground. For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6m x 0.8m x 0.8m high non-conductive table with a 3.175mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50cm x 50cm x 3.175mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. For each of the other tests, the HCP is removed.

RF Field Immunity testing is performed in a 7.3m x 3.7m x 3.2m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.9m x 3.7m x 3.175mm thick aluminum ground plane which is connected to one end of the anechoic chamber.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st addition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities. The term standard uncertainty is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. The fraction may be viewed as the coverage probability or level of confidence of the interval.

The test system for conducted emissions is defined as the LISN, spectrum analyzer, coaxial cables, and pads. The test system for radiated emissions is defined as the antenna, spectrum analyzer, pre-amplifier, coaxial cables, and pads. The conducted test system has a combined standard uncertainty of ± 1.2 dB. The radiated test system has a combined standard uncertainty of ± 1.6 dB. The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Guide 25.

2.5 Configuration

Two special "FCC Test" software loads will be created for the Reader, which will cause it to transmit maximum traffic, even though it is not installed in a working system environment. One software version will perform the Part 15.249 signaling, and the other will perform Part 15.247 signaling. This software will speed up all RF measurements. Since the EUT is powered by 120 VAC, the transmitters can run indefinitely without battery limitations. The transmitters will operate at their maximum power output of +8dBm (in the Part 15.247 mode) and will be connected to the devices integrated horizontal and vertical antennas. The transceivers will also spend some of their time in receive mode, to allow detection of possible out of band emissions. This Test report will be concerned only with the Part 15.247 mode.

A representative from the OEM will be on hand to assist testing. Spare samples will also be on hand. We propose the following measurement sequence:

- The transmitter fundamental is <1 GHz, thus no measurements are required above 10 GHz
- Use 1.2 GHz high-pass filter for measurements above 1GHz (filter avoids SA front-end overload when measuring harmonics/spurs)
- Radiated power/spurious (X, Y, Z axes from 30MHz to 10GHz)
- Band edge - a plot showing that the left edge of the lowest frequency is above 902 MHz, and that the right edge of the high frequency is less than 928 MHz. Mark the -20 dBc point from the peak closest to the band edge

2.5.1 RadarFind Deliverables for FCC Part 15.247 Evaluation

RadarFind will supply a Part 15.247 version of the Reader test sample. It will be loaded with special software which will continuously exercise the two transmitters in the following manner:

- Pseudo-random frequency per the tables in Section 2
- Each of two transmitters transmitting simultaneously, but at different places in the FHSS table (resulting in simultaneous transmissions on different frequencies)
- Transmitter "on time" of 30ms
- Receiver "on time" (between frequency hops) of 10ms
- Maximum transmit power of +8dBm per transmitter
- Transmitter bit rate of 31250 bits per second modulated FSK with deviation of approximately 225 kHz.

The serial number of the EUT submitted for testing in "Hop Mode" is Not Serialized.

3 Antenna Port Conducted Emissions – in "Hop" mode

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.4:2003 and FCC Public Notice # DA 00-705. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

3.1 Channel Separation Part 15.247(a)

Frequency hopping Systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Maximum 20dB Bandwidth = 274.1 kHz

Channel Separation = 300 kHz

The channel separation is greater than the measured maximum 20 dB bandwidth. Therefore the EUT is compliant with this section.

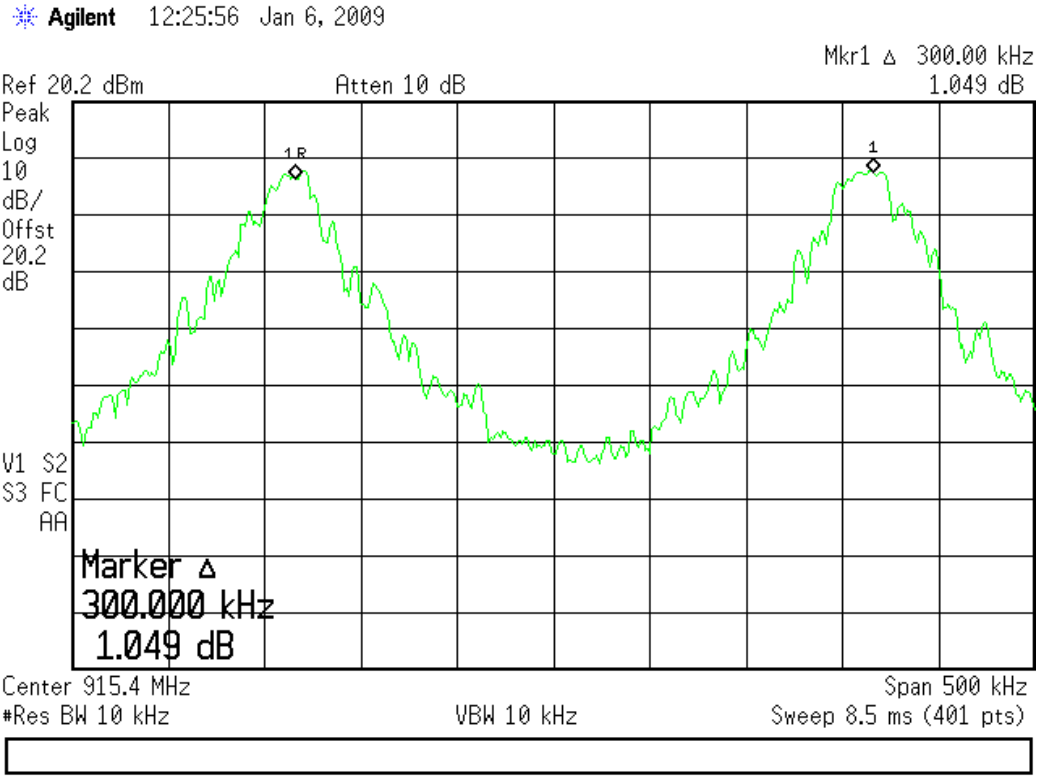


Figure 1: Channel Separation = 300 kHz

Spectrum Analyzer Parameters:
RBW=10kHz, VBW= 10kHz
Span=750kHz
LOG dB/div.= 10dB
Sweep = Auto, Detector = peak detector, max hold

3.2 Pseudorandom Hopping Algorithm FCC Part 15.247(a)(1)(i)

The channel bandwidth for this system is greater than 250 kHz. Therefore the system must use at least 25 channels that are selected at the system hopping rate, from a pseudo-randomly ordered list of hopping frequencies. Each frequency must be used equally on average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their transmitters and shall shift frequencies in synchronization with the transmitted signals.

Each packet is sent on the next channel determined by the pseudo-random hop sequence given in the operation description

The graphs below show the 62 hopping channels of the apparatus.

Note: The frequencies were divided into two plots to clearly show the hopping channels.

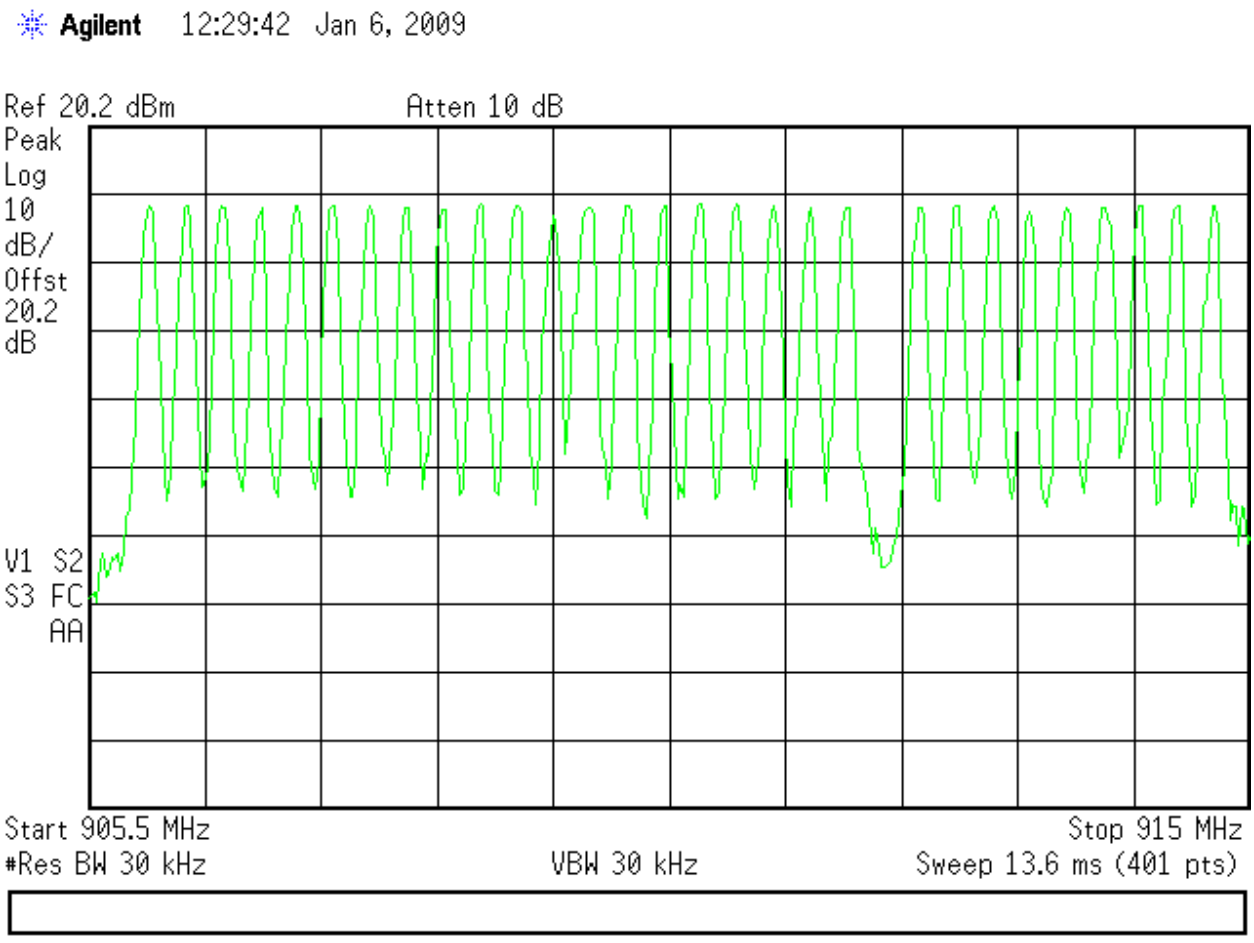


Figure 2: Plot of hopping Channels 0 to 28 from 905.5-915 MHz

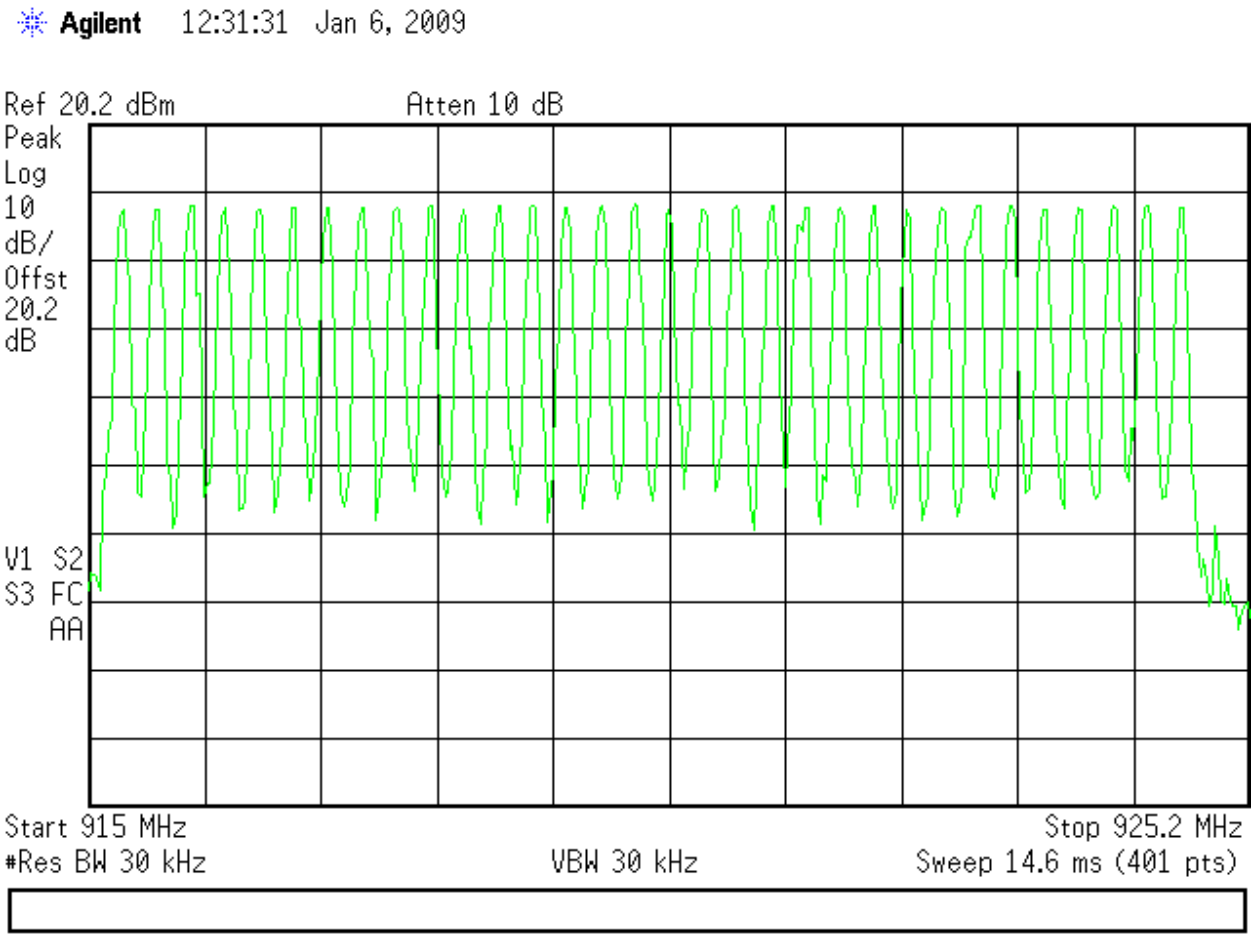


Figure 3: Plot of hopping Channels 29 to 61 from 915-925.2 MHz

Spectrum Analyzer Parameters:
RBW=100 kHz
Span=10.2 MHz
VBW= 3kHz
LOG dB/div.= 10dB
Sweep = Auto
Detector = peak detector, max hold

Time of Occupancy FCC Part 15.247(a)(1)(i)

Frequency Band (MHz)	20 dB Bandwidth	Number of Hopping Channels	Average Time of Occupancy
906 - 927.6	=>250 kHz	62	≤ 0.4 sec. In 10 sec.

There were 4 hops for any 10 sec. Period. Time of occupancy equals number of hops multiplied by the duration of one hop.

Time of Occupancy limit = 0.400 seconds in any 10 second period.
Calculated Time of Occupancy = 0.031 seconds x 4 = 0.124 seconds in any 10 second period

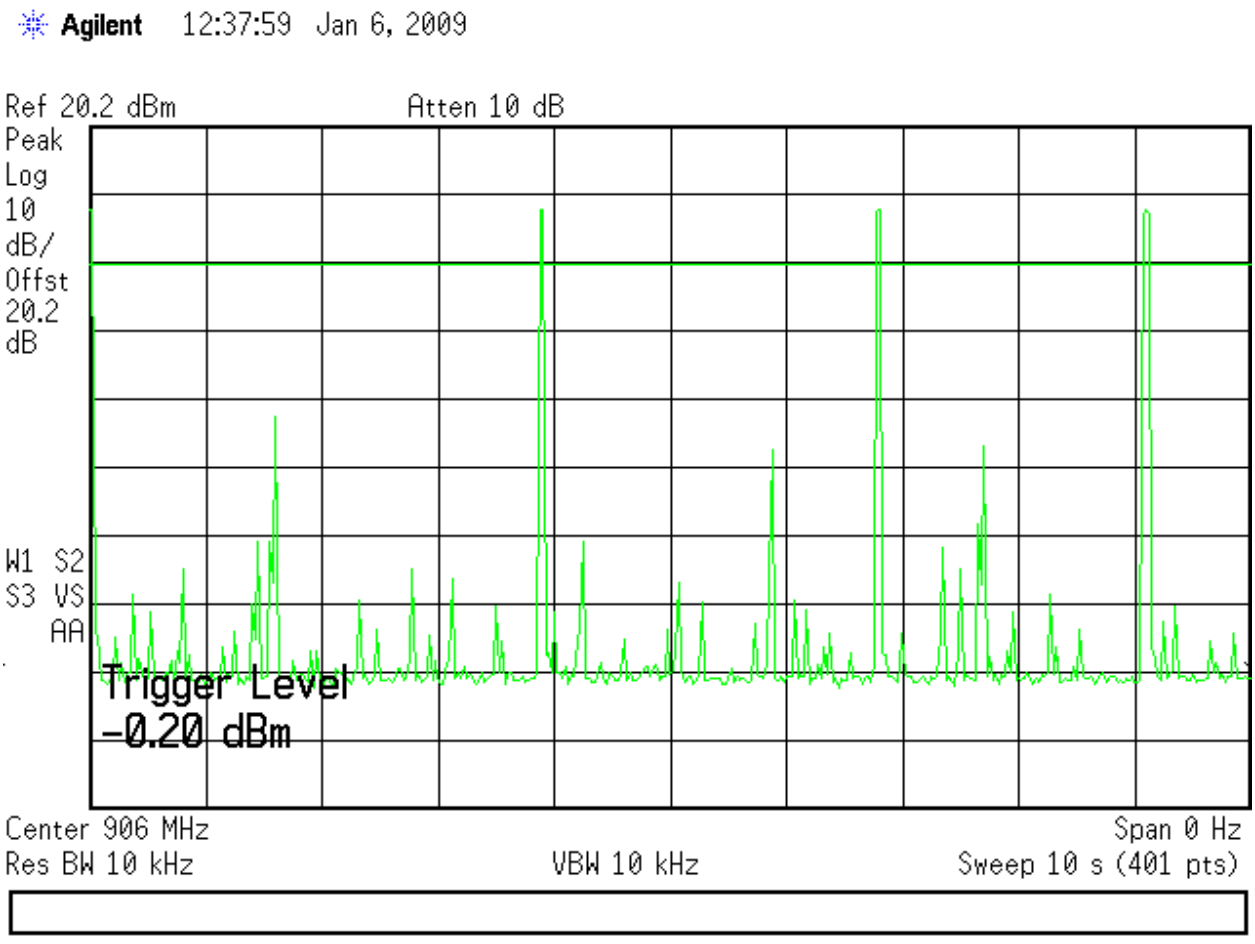


Figure 4: 10 second sweep

Note: The on-channel traces are the four highest peaks.

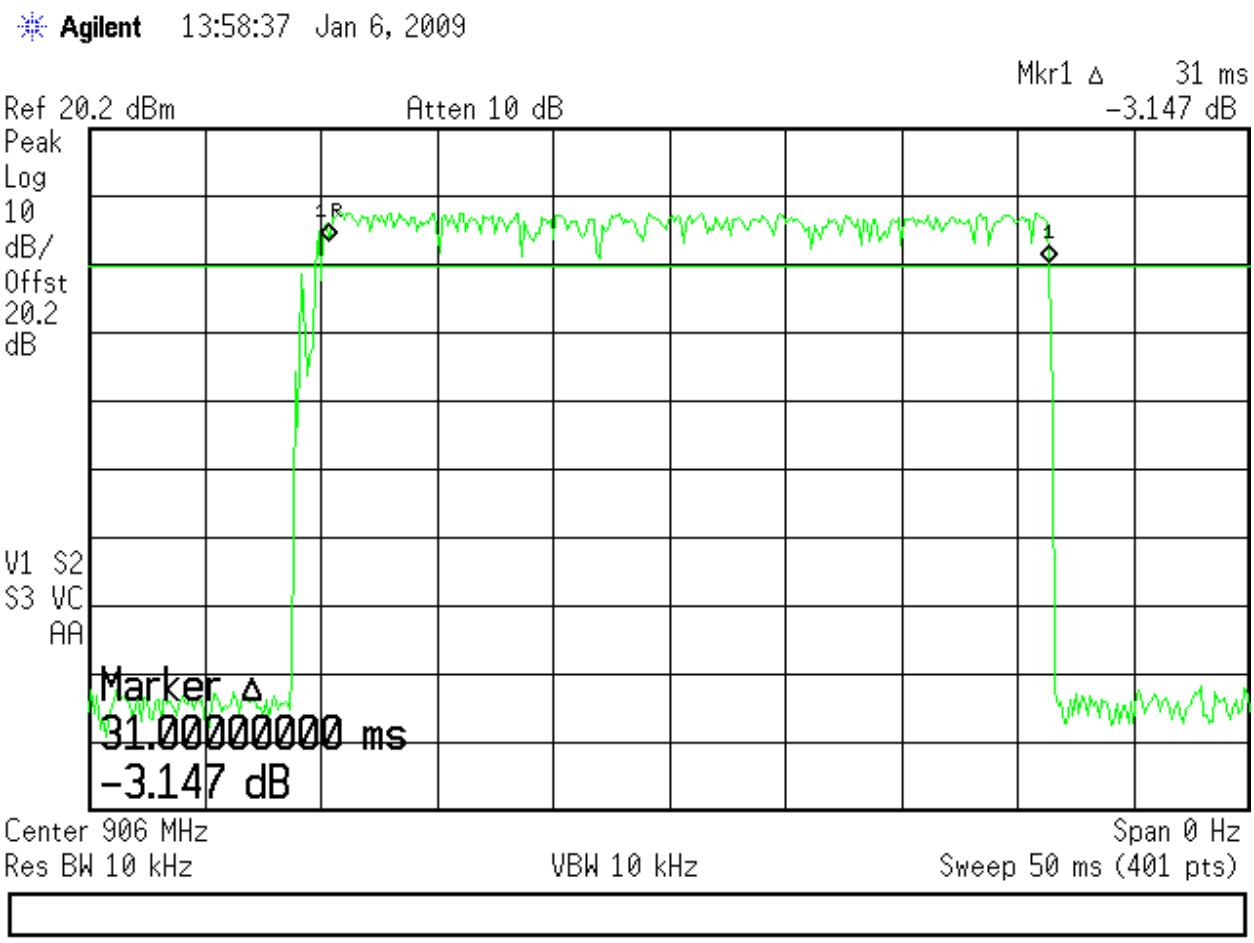


Figure 5: Time on Frequency for 1 hop

Time on Frequency = 31.0 ms

Spectrum Analyzer Parameters:
RBW = 10 kHz
Span = zero
VBW = 10 kHz
LOG dB/div. = 10dB
Sweep = 50 ms
Detector = peak detector

3.3 Occupied Bandwidth FCC Part 15.247(a)(1)(i)

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

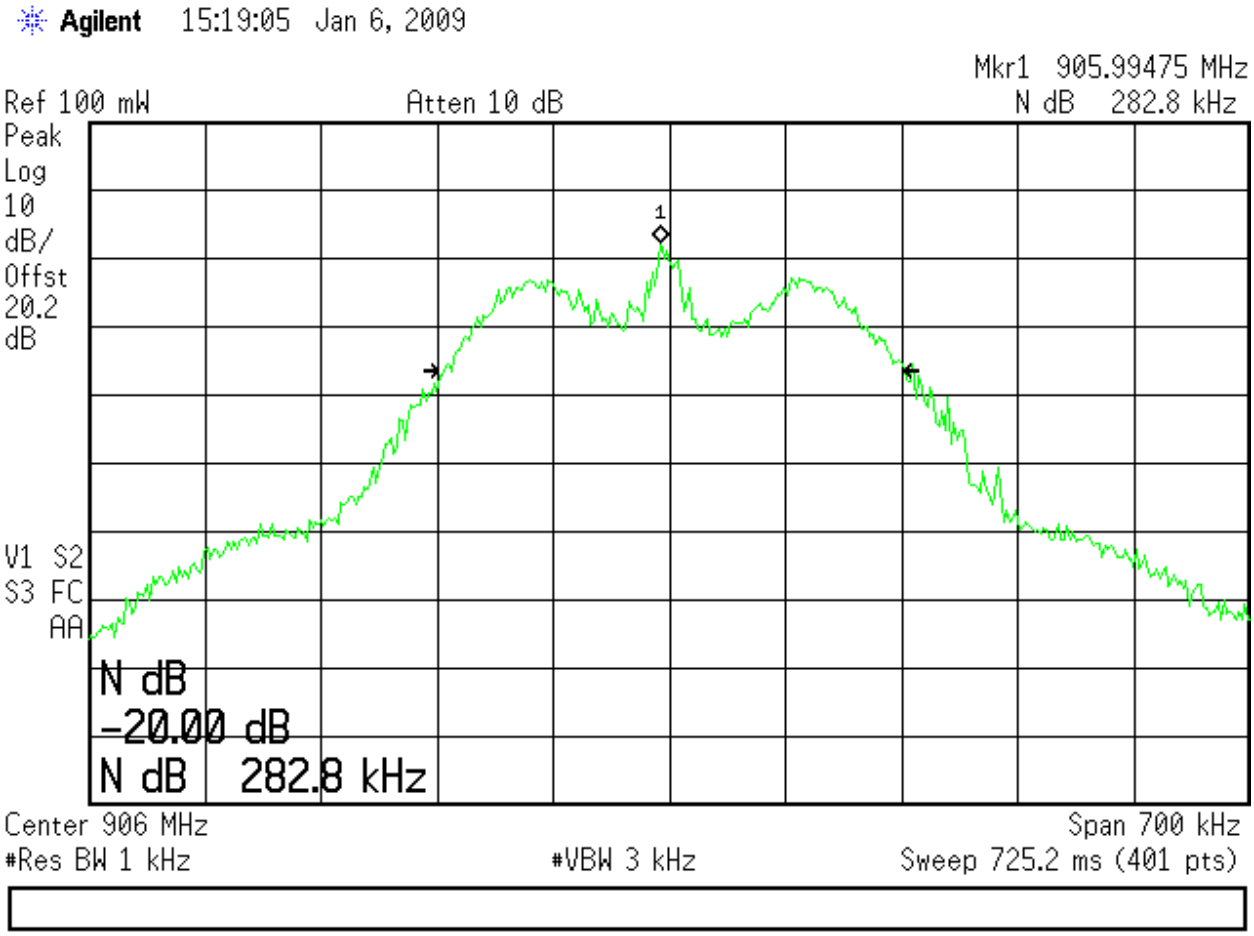


Figure 6: CH 00 (906.0 MHz) 20dB Occupied Bandwidth

Note: The above plot is the worst case.

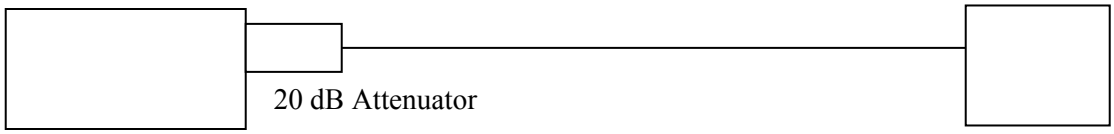
Bandwidth = 282.8 kHz

3.4 Peak Output Power FCC Part 15.247(b)(2)

The maximum peak output power of the intentional radiator shall not exceed 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels. (Conducted Measurement)

The peak output power was measured at CH01, CH29, and at CH61. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The cable loss and the attenuator was measured and added in the reference level offset in the spectrum analyzer. The spectrum analyzer's resolution bandwidth was greater than the 20dB bandwidth of the modulated carrier and the video bandwidth was equal to the resolution bandwidth.

Test Setup



Spectrum Analyzer EUT RF Output connection

Peak Power Output

CH00: 906.0 MHz = 0.006800 Watts = 8.33 dBm = 115.32 dBµV

CH30: 915.6 MHz = 0.006421 Watts = 8.08 dBm = 115.07 dBµV

CH61: 924.9 MHz = 0.006283 Watts = 7.98 dBm = 114.97 dBµV

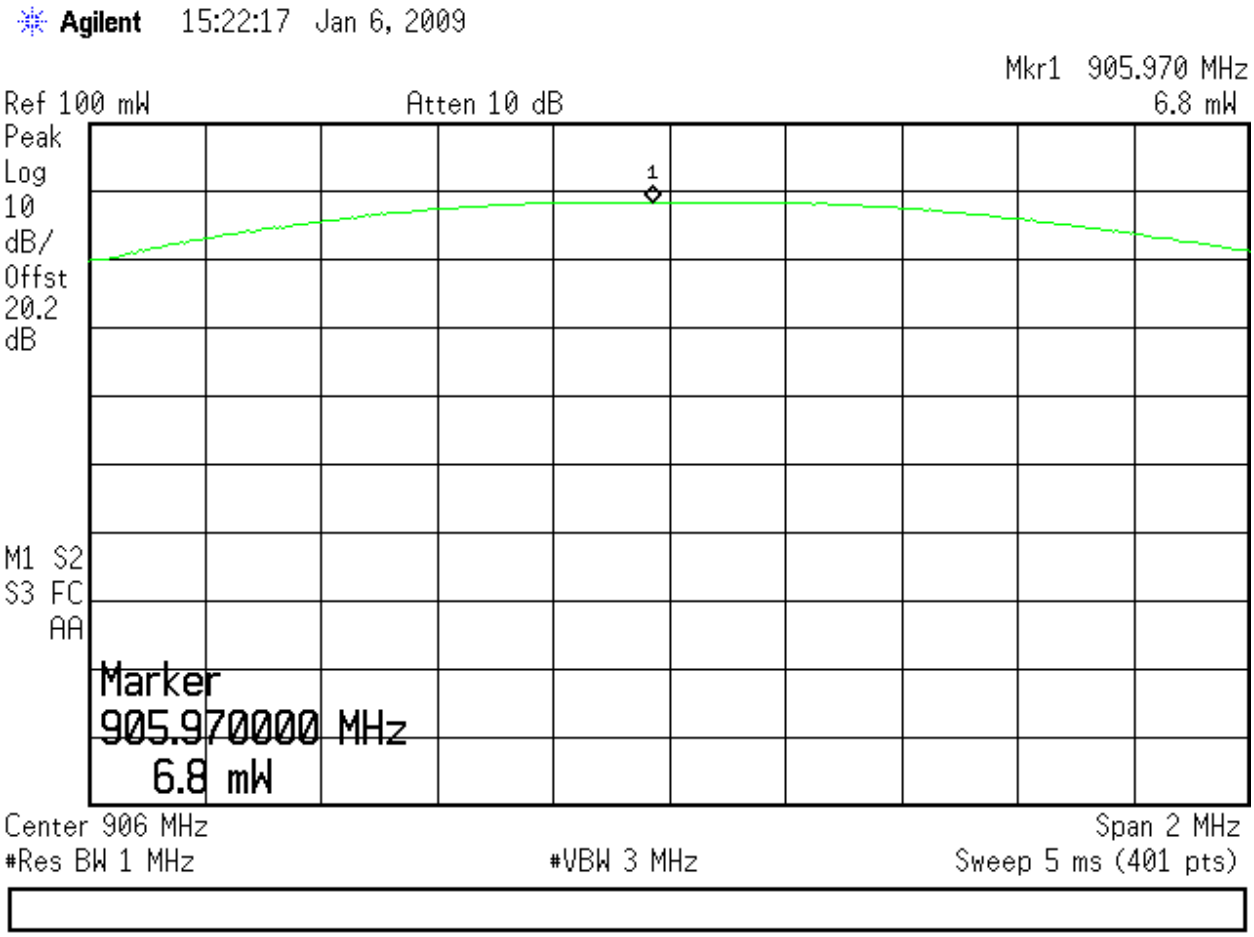


Figure 7: CH 00 (906.0 MHz) Peak Output Power

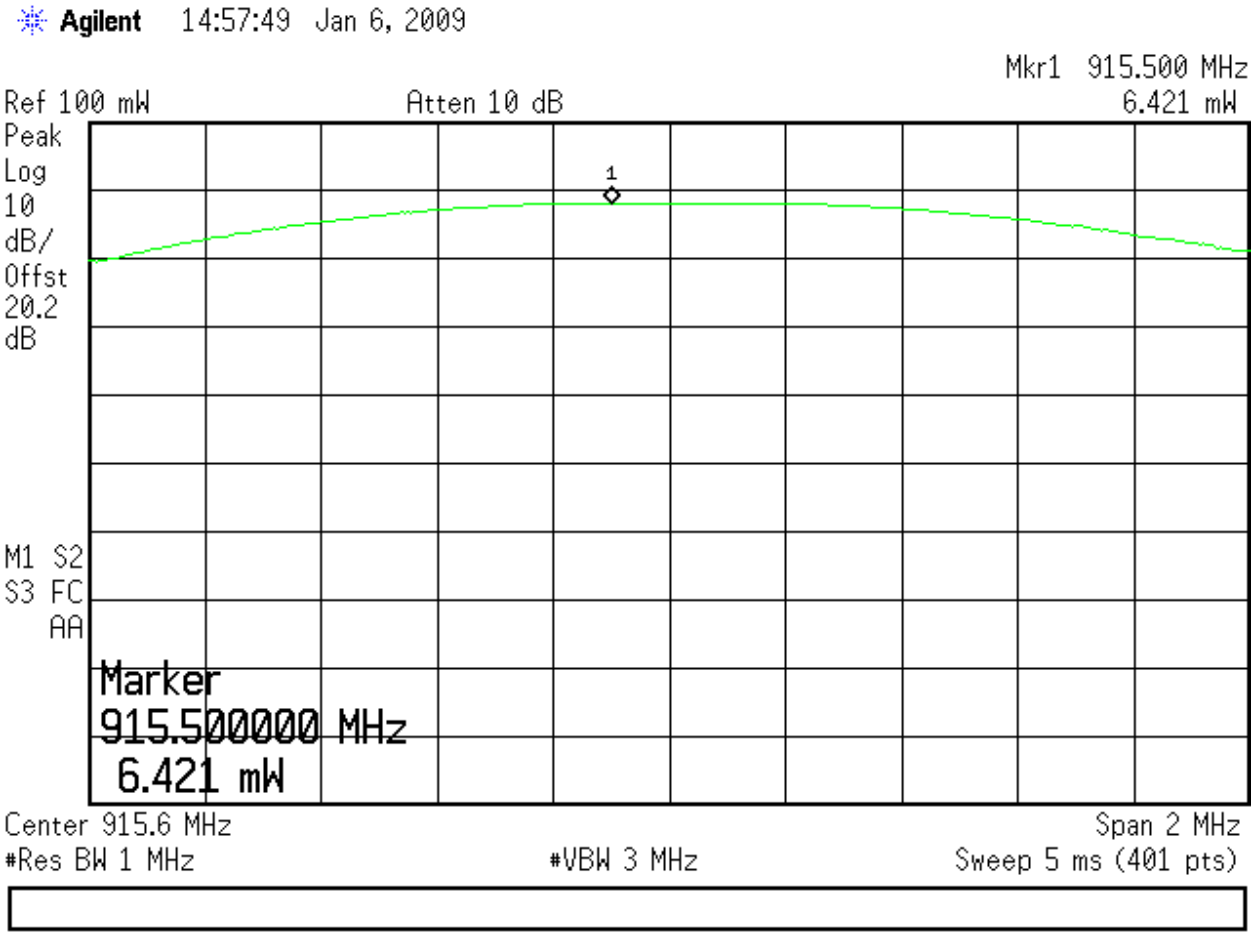


Figure 8: CH 30 (915.6 MHz) Peak Output Power

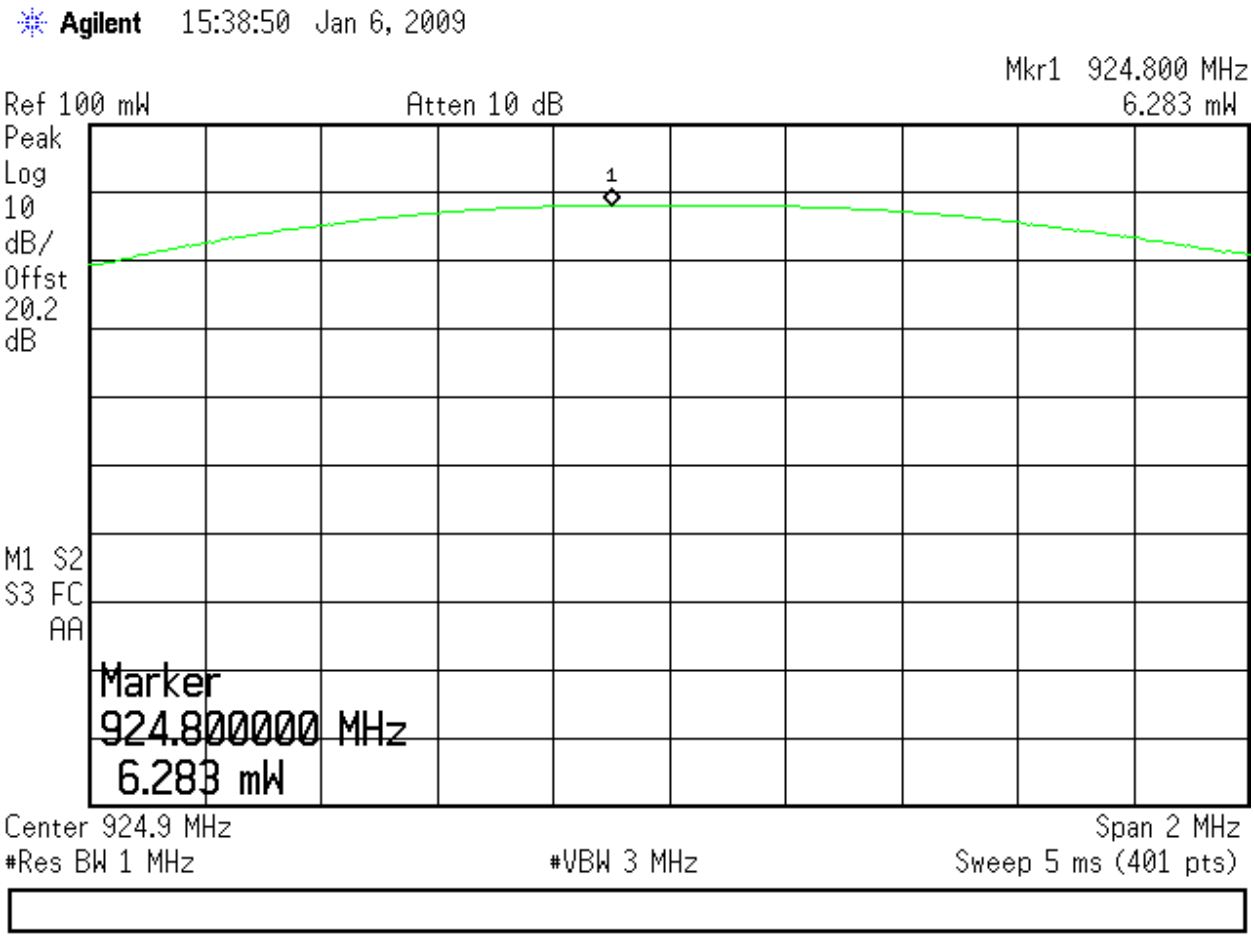


Figure 9: CH 61 (924.9 MHz) Peak Output Power

3.4.1 Antenna Gain

The antenna gain data was supplied separately with the following results provided:

3.4.1.1 Results

Antennas

Freq. (GHz)	Peak (dBi)
0.902 – 0.928	6.0 (Max)

4 Spurious Emissions - in "Hop" Mode

4.1 Spurious Emissions FCC Part 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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.

4.1.1 Test Methodology

4.1.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 300 kHz and provide a reading at each frequency for each 6° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.1.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

4.1.1.3 Deviations

There were no deviations from this test methodology.

4.1.2 Test Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

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EUT Name	Reader	**Date**	08 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 34% rH
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	12	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3 meters / 3115 above 1 GHz	**Performed by**	Mark Ryan
Configuration	Vertical transmitter on Ch 1 – 906 MHz (modulated), Horizontal Antenna off.		

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dBuV/m)
906.00	H	1.7	36	72.28	0.00	3.38	22.52	98.18	-20 dBc	51.18
1812.00	H	1.3	331	60.33	36.11	6.35	26.84	57.40	78.18	-20.78
2718.00	H	1.3	254	36.54	35.99	7.84	29.71	38.11	78.18	-40.07
3624.00	H									*
4530.00	H	1	185	33.45	35.86	10.61	32.47	40.67	78.18	-37.51
5436.00	H									*
6342.00	H									*
7248.00	H									*
8154.00	H									*
9060.00	H								.	*
906.00	V	1.28	0	85.54	0.00	3.38	22.30	111.22	-20 dBc	64.22
1812.00	V	1.1	77	71.49	36.11	6.35	26.59	68.31	91.22	-22.91
2718.00	V	1.62	303	39.02	35.99	7.84	29.24	40.12	91.22	-51.10
3624.00	V									*
4530.00	V	1	0	27.10	35.86	10.61	32.65	34.51	91.22	-56.71
5436.00	V									*
6342.00	V									*
7248.00	V									*
8154.00	V									*
9060.00	V									*

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

*Only the 2nd, 3rd and 5th harmonics were measurable, all other harmonics were indistinguishable from the EMC receiver's noise floor.

SOP 1 Radiated Emissions

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EUT Name	Reader	**Date**	08 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 34% rH
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	12	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3 meters / 3115 above 1 GHz	**Performed by**	Mark Ryan
Configuration	One transmitter hopping, the other on Ch 30 – 915.6 MHz (modulated)		

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dBuV/m)
915.60	H	1	321	69.90	0.00	4.45	22.61	96.97	-20dBc	
1831.20	H	1.3	35	64.40	36.15	6.34	26.92	61.51	76.97	-15.46
2746.80	H	1.1	40	40.59	35.93	7.93	29.79	42.38	76.97	-34.59
3662.40	H									*
4578.00	H	1.2	174	40.10	35.94	10.92	32.57	47.65	76.97	-29.32
5493.60	H									*
6409.20	H									*
7324.80	H									*
8240.40	H									*
9156.00	H									*
915.60	V	1.3	0	84.56	0.00	4.45	22.31	111.33	-20dBc	
1831.20	V	1.1	94	70.05	36.15	6.34	26.66	66.90	91.33	-24.43
2746.80	V	1.3	243	43.14	35.93	7.93	29.34	44.48	91.33	-46.85
3662.40	V									*
4578.00	V	1	105	39.11	35.94	10.92	32.74	46.83	91.33	-44.50
5493.60	V									*
6409.20	V									*
7324.80	V									*
8240.40	V									*
9156.00	V									*

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

*Only the 2nd, 3rd and 5th harmonics were measurable, all other harmonics were indistinguishable from the EMC receiver's noise floor.

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EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	12	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3 meters / 3115 above 1 GHz	**Performed by**	Mark Ryan
Configuration	One transmitter hopping, the other on Ch 61 – 924.9 MHz (modulated)		

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dBuV/m)
924.90	H	1	329	67.95	0.00	4.45	22.80	95.19	-20dBc	
1849.80	H	1.2	33	63.65	36.17	6.36	27.01	60.84	75.19	-14.35
2774.70	H	1.5	322	36.51	35.97	8.03	29.87	38.44	75.19	-36.75
3699.60	H									*
4624.50	H	1.7	18	34.39	36.00	10.84	32.67	41.91	75.19	-33.28
5549.40	H									*
6474.30	H									*
7399.20	H									*
8324.10	H									*
9249.00	H									*
924.90	V	1.2	16	85.00	0.00	4.45	22.50	111.94	-20dBc	
1849.80	V	1.5	328	68.70	36.17	6.36	26.73	65.61	91.94	-26.33
2774.70	V	V	1.1	39.22	35.97	8.03	29.43	40.71	91.94	-51.23
3699.60	V									*
4624.50	V	1.1	0	31.44	36.00	10.84	32.82	39.11	91.94	-52.83
5549.40	V									*
6474.30	V									*
7399.20	V									*
8324.10	V									*
9249.00	V									*

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

*Only the 2nd, 3rd and 5th harmonics were measurable, all other harmonics were indistinguishable from the EMC receiver's noise floor.

4.1.2.1 Restricted band measurements

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)). In addition, where an average detector is used for determining compliance with the limits in 15.209(a), there is a corresponding peak limit 20 dB above the specified average limit according to 15.35(b)

Measurements demonstrating compliance with these parts are provided in the tables below.

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EUT Name	Reader	**Date**	08 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 34% rH
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	6	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3 meters / 3115	**Performed by**	Mark Ryan
Configuration	One transmitter hopping, the other on Ch 00 – 906 MHz (modulated)		

Emission Freq (MHz)	ANT Polar (H)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Peak										
2718.00	H	1.3	254	39.02	35.99	7.84	29.71	40.59	74.00	-33.41
3624.00	H									*
4530.00	H	1	185	33.45	35.94	10.93	32.58	41.01	74.00	-32.99
5436.00	H									*
8154.00	H									*
9060.00	H									*
Average										
2718.00	H	1.3	254	21.34	35.99	7.84	29.71	22.91	54.00	-31.09
3624.00	H									*
4530.00	H	1	185	14.55	35.86	10.61	32.47	21.77	54.00	-32.23
5436.00	H									*
8154.00	H									*
9060.00	H									*

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: RBW/VBW = 1MHz/1MHz For frequencies between 1GHz and 10 GHz

Note: Peak measurements were made to document compliance with 15.247(c) and compliance with 15.35b. In addition, average measurements were made to document compliance with 15.205(b) for spurious emissions falling in the restricted bands.

*Only the 2nd, 3rd and 5th harmonics were measurable, all other harmonics were indistinguishable from the EMC receiver's noise floor.

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EUT Name	Reader	**Date**	08 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 34% rH
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	6	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3 meters / 3115	**Performed by**	Mark Ryan
Configuration	One transmitter hopping, the other on Ch 00 – 906 MHz (modulated)		

Emission Freq (MHz)	ANT Polar (V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Peak										
2718.00	V	1.3	254	36.54	35.99	7.84	29.24	37.64	74.00	-36.36
3624.00	V									*
4530.00	V	1	0	27.10	35.86	10.61	32.65	34.51	74.00	-39.49
5436.00	V									*
8154.00	V									*
9060.00	V									*
Average										
2718.00	V	1.3	254	20.23	35.99	7.84	29.24	21.33	54.00	-32.67
3624.00	V									*
4530.00	V	1	0	14.39	35.86	10.61	32.65	21.80	54.00	-32.20
5436.00	V									*
8154.00	V									*
9060.00	V									*

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: RBW/VBW = 1MHz/1MHz For frequencies between 1GHz and 10 GHz

Note: Peak measurements were made to document compliance with 15.247(c) and compliance with 15.35b. In addition, average measurements were made to document compliance with 15.205(b) for spurious emissions falling in the restricted bands.

*Only the 2nd, 3rd and 5th harmonics were measurable, all other harmonics were indistinguishable from the EMC receiver's noise floor.

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EUT Name	Reader	**Date**	08 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 34% rH
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	6	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3 meters / 3115	**Performed by**	Mark Ryan
Configuration	One transmitter hopping, the other on Ch 30 – 915.6 MHz (modulated)		

Emission Freq (MHz)	ANT Polar (H)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Peak										
2746.80	H	1.1	40	40.59	35.93	7.93	29.79	42.38	74.00	-31.62
3662.40	H									*
4578.00	H	1.2	174	40.10	35.94	10.92	32.57	47.65	74.00	-26.35
7324.80	H									*
8240.40	H									*
9156.00	H									*
Average										
2746.80	H	1.1	40	25.41	35.93	7.93	29.79	27.20	54.00	-26.80
3662.40	H									*
4578.00	H	1.2	174	29.06	35.94	10.92	32.57	36.61	54.00	-17.39
7324.80	H									*
8240.40	H									*
9156.00	H									*

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: RBW/VBW = 1MHz/1MHz For frequencies between 1GHz and 10 GHz

Note: Peak measurements were made to document compliance with 15.247(c) and compliance with 15.35b. In addition, average measurements were made to document compliance with 15.205(b) for spurious emissions falling in the restricted bands.

*Only the 2nd, 3rd and 5th harmonics were measurable, all other harmonics were indistinguishable from the EMC receiver's noise floor.

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EUT Name	Reader	**Date**	08 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 34% rH
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	6	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3 meters / 3115	**Performed by**	Mark Ryan
Configuration	One transmitter hopping, the other on Ch 30 – 915.6 MHz (modulated)		

Emission Freq (MHz)	ANT Polar (V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Peak										
2746.80	V	1.3	243	43.14	35.93	7.93	29.34	44.48	74.00	-29.52
3662.40	V									*
4578.00	V	1	105	39.11	35.94	10.92	32.74	46.83	74.00	-27.17
7324.80	V									*
8240.40	V									*
9156.00	V									*
Average										
2746.80	V	1.3	243	35.28	35.93	7.93	29.34	36.62	54.00	-17.37
3662.40	V									*
4578.00	V	1	105	26.94	35.94	10.92	32.74	34.66	54.00	-19.34
7324.80	V									*
8240.40	V									*
9156.00	V									*

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: RBW/VBW = 1MHz/1MHz For frequencies between 1GHz and 10 GHz

Note: Peak measurements were made to document compliance with 15.247(c) and compliance with 15.35b. In addition, average measurements were made to document compliance with 15.205(b) for spurious emissions falling in the restricted bands.

*Only the 2nd, 3rd and 5th harmonics were measurable, all other harmonics were indistinguishable from the EMC receiver's noise floor.

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EUT Name	Reader	**Date**	08 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 34% rH
EUT Serial	07 672 721	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	12	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3 meters / 3115	**Performed by**	Mark Ryan
Configuration	One transmitter hopping, the other on Ch 61 – 924.9 MHz (modulated)		

Emission Freq (MHz)	ANT Polar (H)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Peak										
2774.70	H	1.5	322	36.51	35.97	8.03	29.87	38.44	74.00	-35.56
3699.60	H									*
4624.50	H	H	1.7	18.00	36.00	10.84	32.67	25.52	74.00	-48.48
7399.20	H									*
8324.10	H									*
Average										
2774.70	H	1.5	322	31.25	35.97	8.03	29.87	33.18	54.00	-20.82
3699.60	H									*
4624.50	H	H	1.7	18.00	36.00	10.84	32.67	25.52	54.00	-28.48
7399.20	H									*
8324.10	H									*

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: RBW/VBW = 1MHz/1MHz For frequencies between 1GHz and 10 GHz

Note: Peak measurements were made to document compliance with 15.247(c) and compliance with 15.35b. In addition, average measurements were made to document compliance with 15.205(b) for spurious emissions falling in the restricted bands.

*Only the 2nd, 3rd and 5th harmonics were measurable, all other harmonics were indistinguishable from the EMC receiver's noise floor.

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EUT Name	Reader	**Date**	08 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 34% rH
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	12	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3 meters / 3115	**Performed by**	Mark Ryan
Configuration	One transmitter hopping, the other on Ch 61 – 924.9 MHz (modulated)		

Emission Freq (MHz)	ANT Polar (V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Peak										
2774.70	V	1.1	0	31.44	35.97	8.03	29.43	32.93	74.00	-41.07
3699.60	V									*
4624.50	V	1.9	5	33.88	36.00	10.84	32.82	41.55	74.00	-32.45
7399.20	V									*
8324.10	V									*
Average										
2774.70	V	1.1	0	17.50	35.97	8.03	29.43	18.99	54.00	-35.01
3699.60	V									*
4624.50	V	1.9	5	18.08	36.00	10.84	32.82	25.75	54.00	-28.25
7399.20	V									*
8324.10	V									*
										*

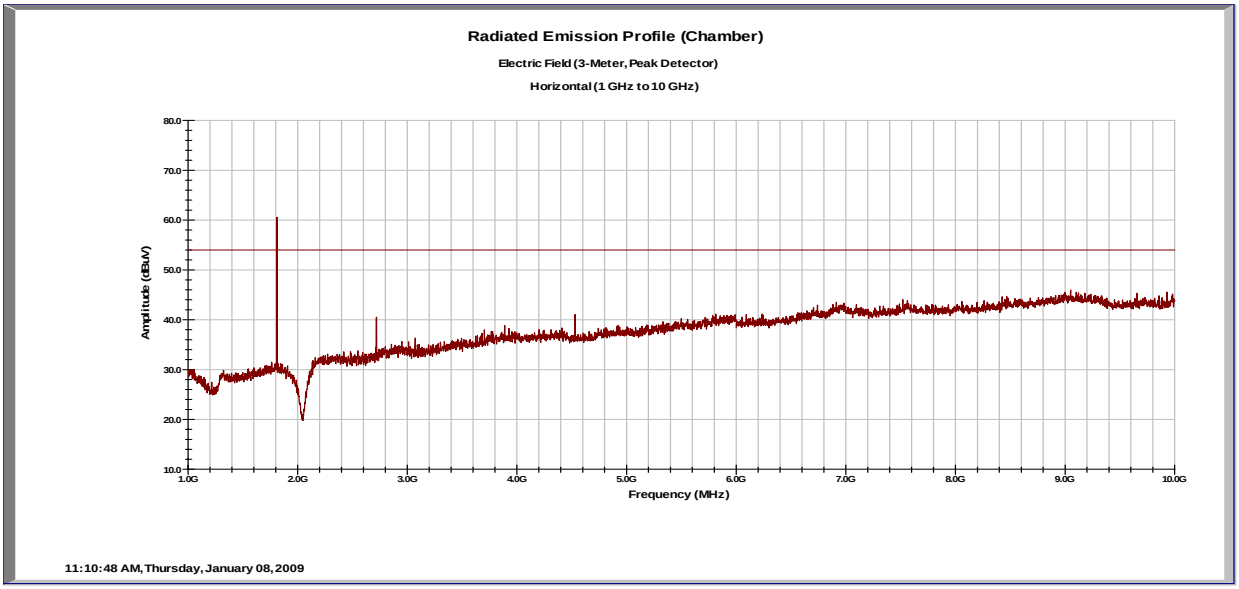
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

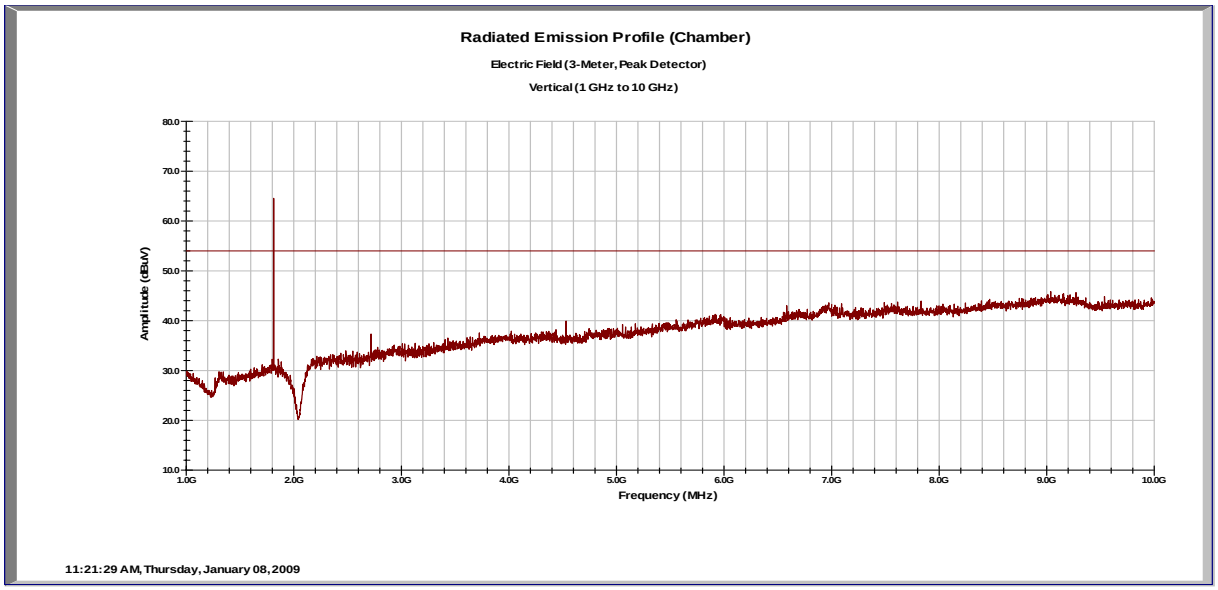
Notes: RBW/VBW = 1MHz/1MHz For frequencies between 1GHz and 10 GHz

Note: Peak measurements were made to document compliance with 15.247(c) and compliance with 15.35b. In addition, average measurements were made to document compliance with 15.205(b) for spurious emissions falling in the restricted bands.

*Only the 2nd, 3rd and 5th harmonics were measurable, all other harmonics were indistinguishable from the EMC receiver's noise floor.



Plot of Mid-band Harmonics and spurs worst case



Plot of Mid-Band Harmonics and spurs worst case

Note: Plots of Low and High Band are on file at TUV Rheinland.

4.2 Emissions Outside the Frequency Band FCC 15.247(d)

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided below to show that the EUT meets these requirements at the band edges.

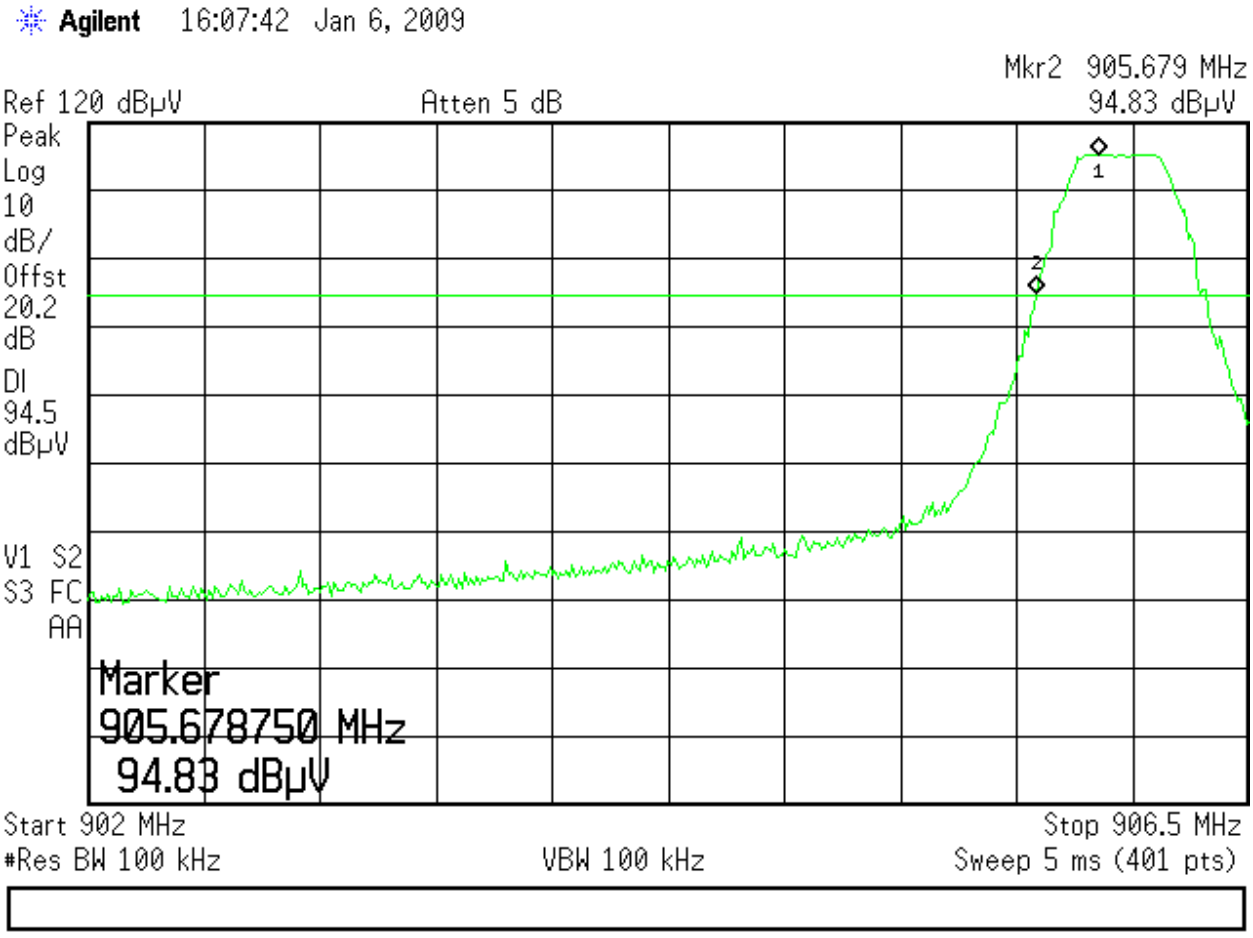


Figure 10: Lower Band Edge Measurement

Note: The Lower Band Edge is at 902 MHz

The lowest Channel Frequency is 906 MHz,

The 20dB down point is at 905.679 MHz which is 3.679 MHz from the band edge.

The EUT is compliant with the rules.

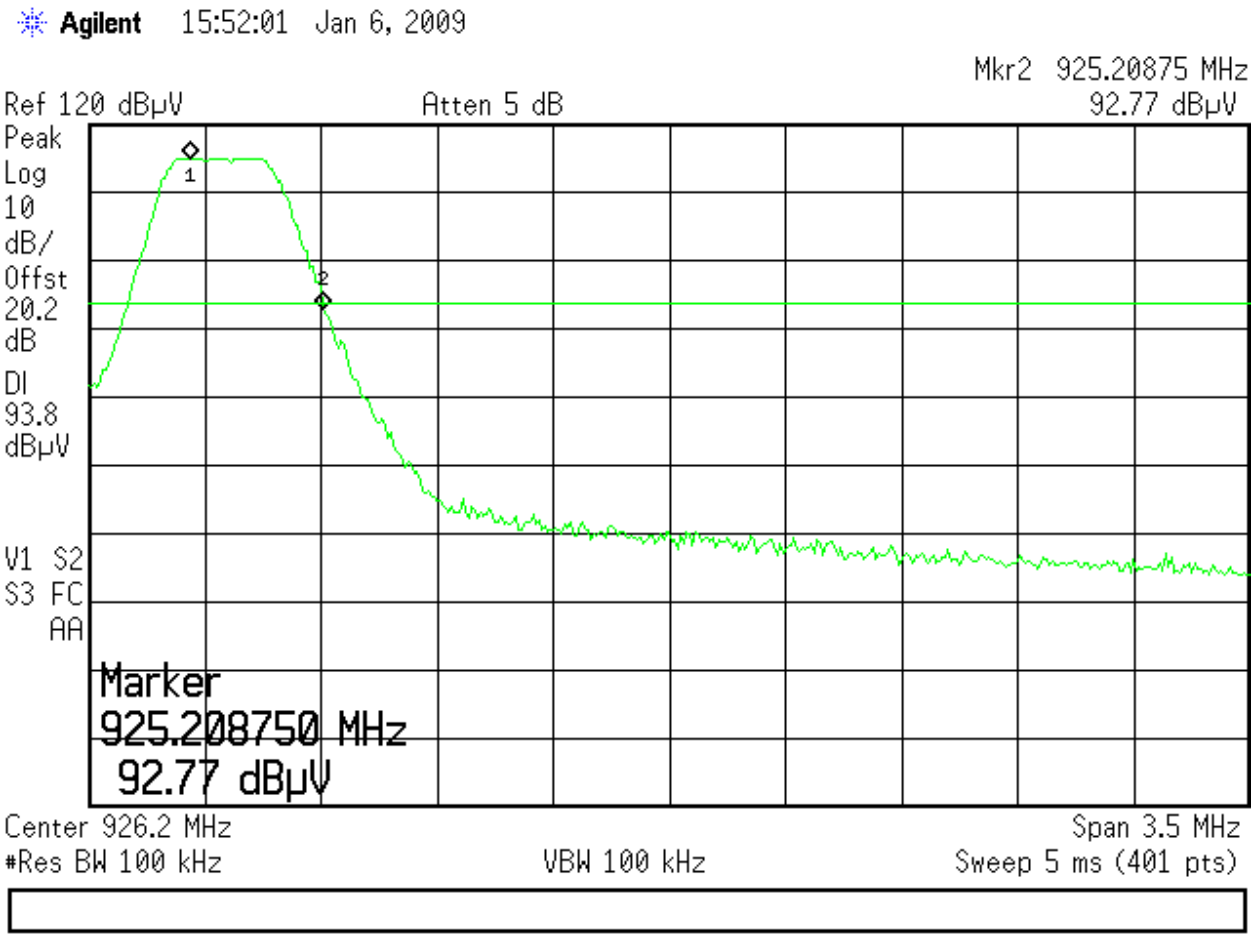


Figure 11: Upper Band Edge Measurement

Note: Start Frequency is 924.5 MHz, and the Stop Frequency is 928 MHz (the upper band edge).

The highest Channel Frequency is 924.9MHz,

The 20dB down point is at 925.209 MHz which is 2.791MHz from the band edge.

The EUT is compliant with the rules.

4.3 Frequency Hopping Spread Spectrum (FHSS) Systems FCC Part 15.247(g)

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The apparatus submitted for testing was loaded with special Reader FCC test software which will continuously exercise the transmitters. The frequencies are defined by a pre-determined pseudo-random sequence. Each of the two identical transmitters will use the same sequence, but at different start points. The transmitter "on time" is set to 30ms, and the receiver "on time" (time between frequency hops) is set to 10ms.

4.4 Incorporation of Intelligence within a FHSS System FCC Part 15.247(h)

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

The EUT does not incorporate intelligence relating to the hopping pattern as described above. Rather, the EUT always distributes its transmissions across the same 62 channels as defined by a pre-defined pseudo-random sequence.

4.5 Radiated Emissions- 30MHz to 1GHz - in "Hop" Mode

Testing was performed in accordance with FCC part 15.209 and RSS210-section 2.6. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.5.1 Test Methodology

4.5.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 300 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.5.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

4.5.1.3 Deviations

There were no deviations from this test methodology.

4.5.2 Test Results

Section 4.5.2.1 lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

4.5.2.1 Final Data

The data recorded in this section contains the final results under the worst-case conditions and with any modifications or special accessories implemented as the manufacturer intends.

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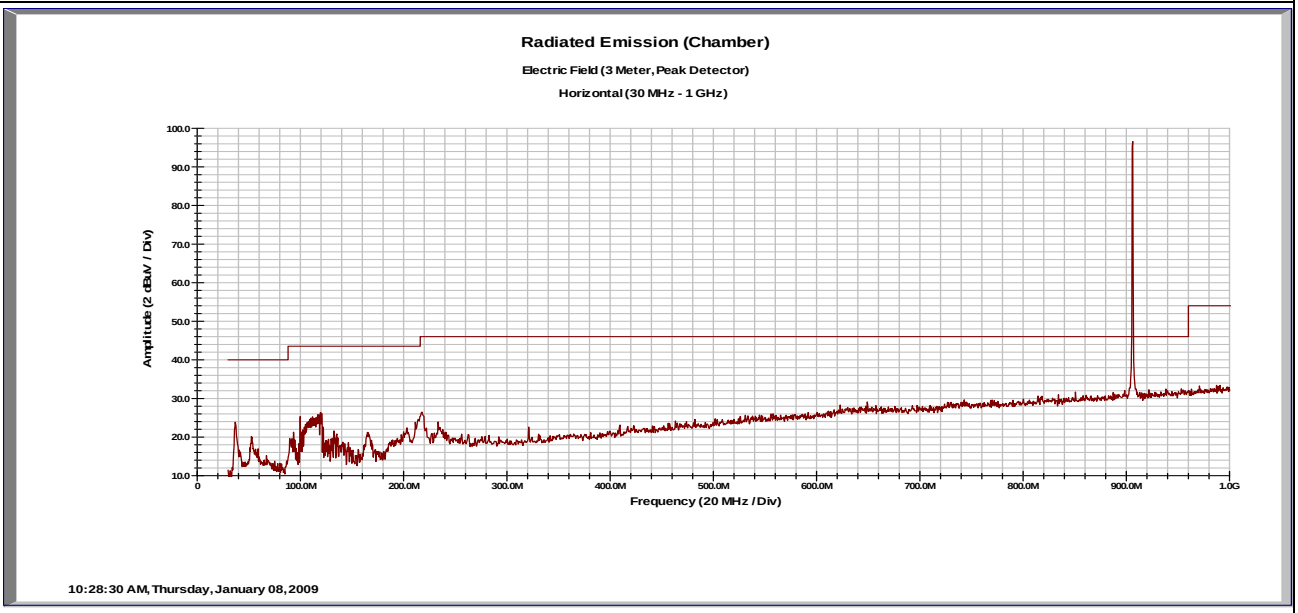
EUT Name	Reader	**Date**	8 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 32% rH
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	12	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / 6140 X-wing	**Performed by**	Mark Ryan
Configuration	EUT in dual Transmit Mode using normal hopping Horizontal.		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
37.84	H	2.8	288	10.34	0.00	0.84	8.51	19.69	40.00	-20.31
89.72	H	2	274	12.75	0.00	1.35	6.68	20.78	40.00	-19.22
99.92	H	1.3	240	16.22	0.00	1.38	8.00	25.60	40.00	-14.40
111.92	H	1.6	271	13.62	0.00	1.49	7.04	22.15	40.00	-17.85
218.16	H	1	127	9.82	0.00	2.08	10.60	22.50	40.00	-17.50

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: The worst case QP emission (outside the operating frequency band) was below the FCC part 15.209 limit, Other plots are on file at TUV Rheinland.
Refer to other sections of this report for emissions inside the operating band.

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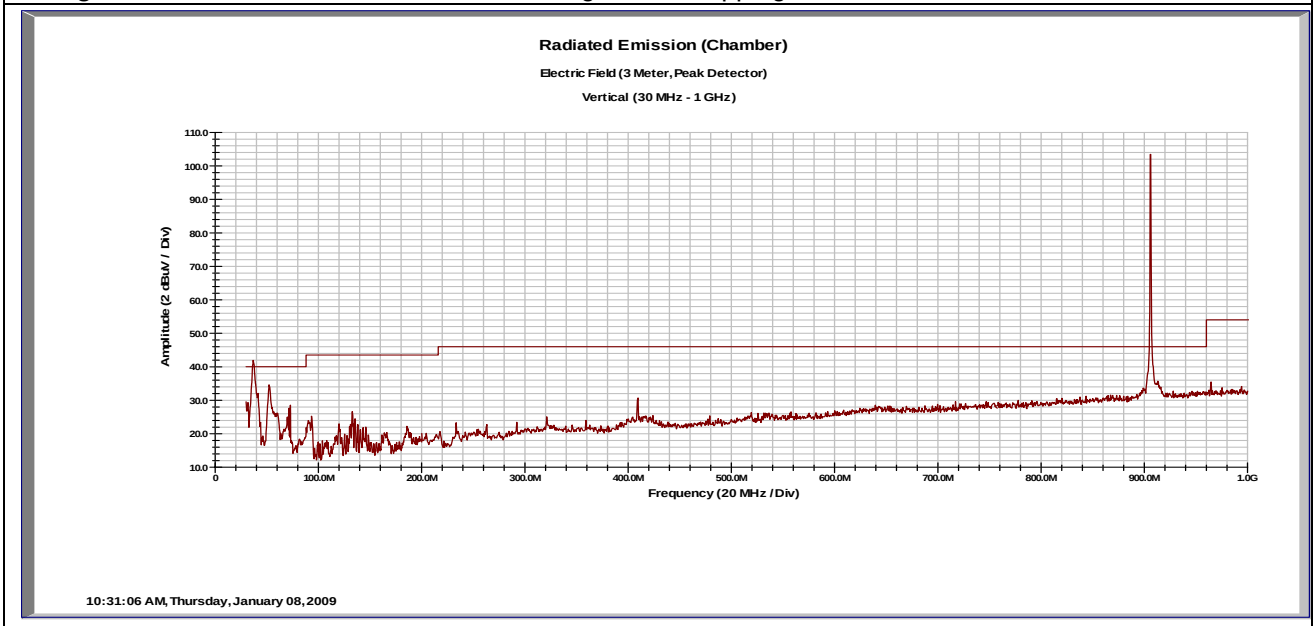
EUT Name	Reader	**Date**	08 January, 2009
EUT Model	R22-1012	**Temp / Hum in**	73 Deg F / 32% rH
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15C	**Line AC / Freq.**	120VAC / 60 Hz
Deg/sweep	12	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / 6140 X-wing	**Performed by**	Mark Ryan
Configuration	EUT in dual Transmit Mode using normal hopping - Vertical.		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM QP Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
37.56	V	1.1	0	27.50	0.00	0.84	8.02	36.35	40.00	-3.65
52.32	V	1	30	17.19	0.00	1.00	9.45	27.64	40.00	-12.36
93.00	V	1	355	6.34	0.00	1.36	6.66	14.36	40.00	-25.64
328.24	V	1.2	299	8.84	0.00	2.61	14.36	25.81	47.00	-21.19

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: The worst case QP emission (outside the operating frequency band) was below the FCC part 15.209 limit, other plots are on file at TUV Rheinland.
Refer to other sections of this report for emissions inside the operating band.

5 Conducted Power Line Emissions

5.1 Conducted Emissions FCC part 15.207 In "HOP" Mode

Testing was performed in accordance with FCC Part 15.207(a). These test methods are listed under the laboratory's NVLAP Scope of Accreditation.

This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

5.1.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. For each frequency sub-range, each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50µH / 50Ω LISNs.

Testing is either performed in the anechoic chamber or on PLC Site 2. The setup photographs clearly identify which site was used. The vertical ground plane used in the anechoic chamber is a 2m x 2m wooden frame that is covered with ¼ inch hardware cloth and is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN. Floor-standing equipment is placed directly on the ground plane.

5.1.1.1 Deviations

There were no deviations from this test methodology.

5.1.2 Test Results

Section 5.1.2.1 lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Plots of the EUT's AC Line Conducted emissions are contained in the following sections. The plots show peak and/or average emissions and the corresponding peak and/or average limits. If the peak emissions are below the average limit, then the EUT is considered to pass and no average measurements are made. If the peak emissions are below the quasi-peak limit and the average emissions are below the average limit, then the EUT is considered to pass and no further measurements are made. Otherwise, individual frequencies are measured and compared to the corresponding limit for the detector used (quasi-peak or average).

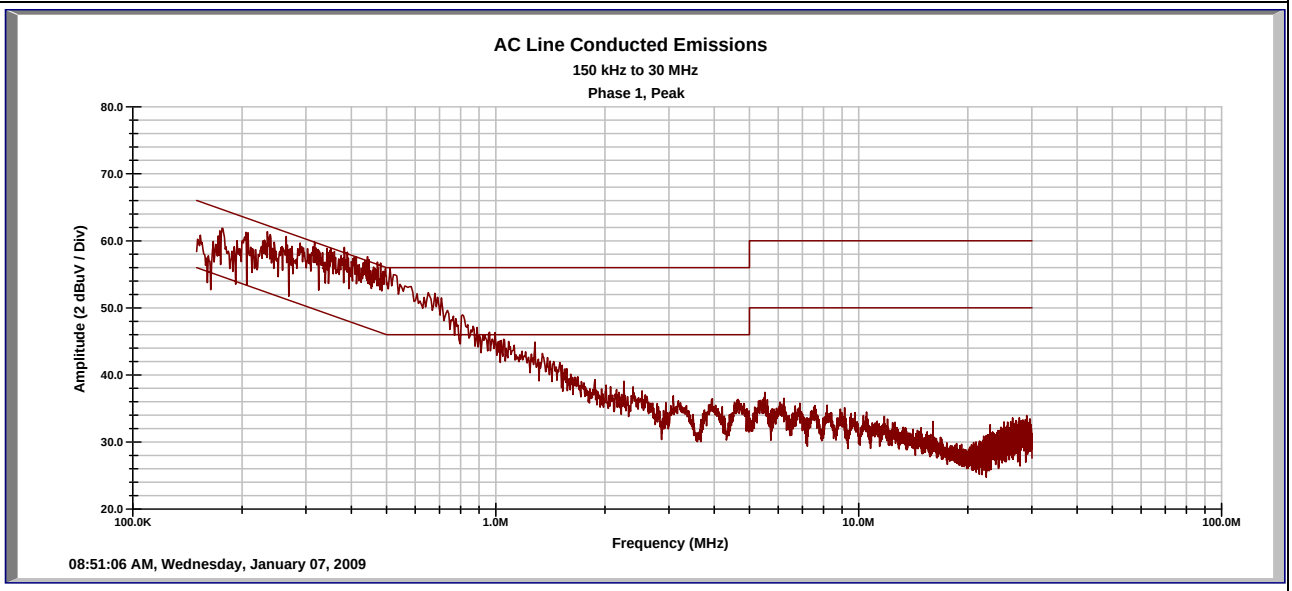
5.1.2.1 Final Data

The data recorded in this section contains the final results under the worst-case conditions and with any modifications or special accessories implemented as the manufacturer intends.

SOP 2 Conducted Emissions

Tracking # 30862910.001 Page 1 of 2

EUT Name	Reader	**Date**	7 January 2009
EUT Model	R22-1012	**Temperature**	71° F
EUT Serial	Not Serialized	**Humidity**	56% rH
Standard	FCC 47 CFR Part 15C	**Line AC /Freq**	120VAC / 60Hz
LISNs Used	16	**Performed by**	Mark Ryan
Configuration:	EUT in “Hop” Mode - Line		



Emission Freq (MHz)	Line ID (1,2,3,N)	FIM Quasi (dBuV)	FIM Ave (dBuV)	Cable Loss (dB)	LISN + T Limiter (dB)	Quasi Limit (dBuV)	Ave Limit (dBuV)	Quasi Spec Margin (dB)	Ave Spec Margin (dB)
0.17	1	43.57	19.87	0.00	10.16	64.96	54.96	-11.23	-24.93
0.38	1	40.95	20.29	0.09	10.17	58.28	48.28	-7.08	-17.74
0.50	1	38.10	18.25	0.07	10.18	56.00	46.00	-7.66	-17.51
0.87	1	29.23	13.29	0.13	10.19	56.00	46.00	-16.45	-22.39
5.43	1	20.02	12.01	0.18	10.37	60.00	50.00	-29.42	-27.43
26.79	1	9.89	0.12	0.20	11.37	60.00	50.00	-38.54	-38.31

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

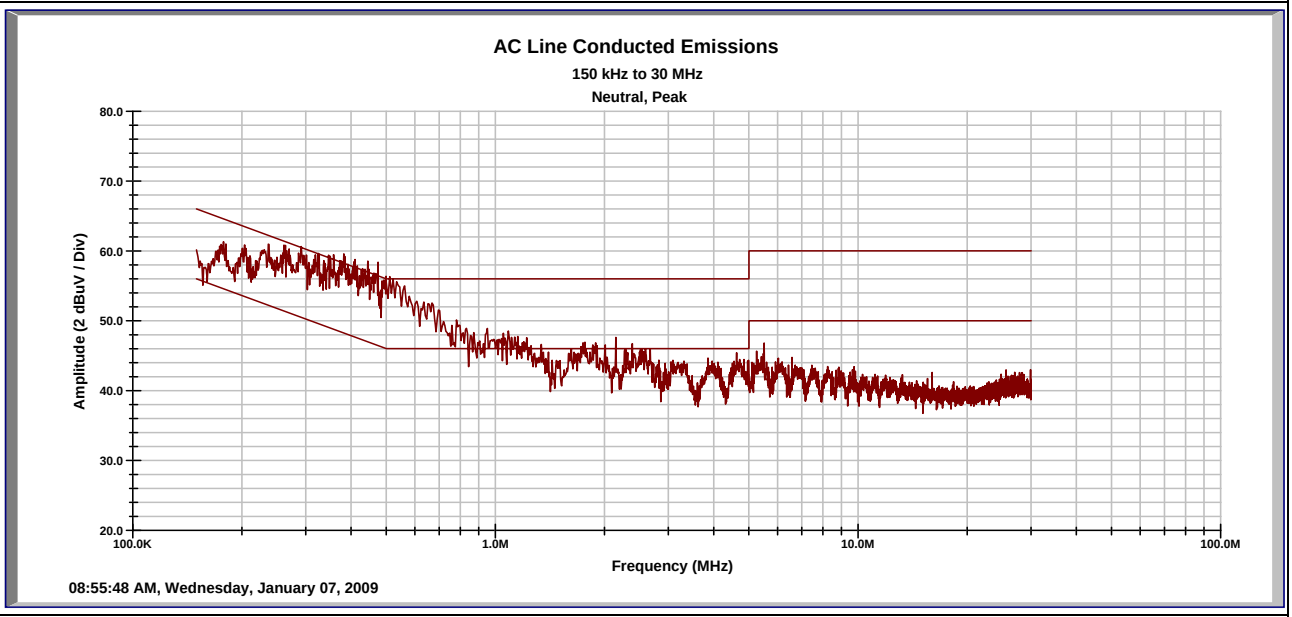
Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

SOP 2 Conducted Emissions

Tracking # 30862910.001 Page 2 of 2

EUT Name	Reader	**Date**	7 January 2009
EUT Model	R22-1012	**Temperature**	71° F
EUT Serial	Not Serialized	**Humidity**	56% rH
Standard	FCC 47 CFR Part 15C	**Line AC /Freq**	120VAC / 60Hz
LISNs Used	15	**Performed by**	Mark Ryan
Configuration:	EUT in “HOP” mode - Neutral		



Emission Freq (MHz)	Line ID (1,2,3,N)	FIM Quasi (dBuV)	FIM Ave (dBuV)	Cable Loss (dB)	LISN + T Limiter (dB)	Quasi Limit (dBuV)	Ave Limit (dBuV)	Quasi Spec Margin (dB)	Ave Spec Margin (dB)
0.18	N	44.50	23.50	0.00	10.14	64.49	54.49	-9.84	-20.84
0.38	N	41.29	24.35	0.09	10.14	58.28	48.28	-6.77	-13.71
0.50	N	40.10	24.53	0.07	10.18	56.00	46.00	-5.65	-11.22
1.09	N	31.51	22.79	0.12	10.30	56.00	46.00	-14.07	-12.79
1.89	N	30.87	22.33	0.10	10.26	56.00	46.00	-14.77	-13.31
2.28	N	28.68	19.36	0.12	10.27	56.00	46.00	-16.94	-16.26
4.68	N	28.87	21.00	0.15	10.37	56.00	46.00	-16.61	-14.48
27.72	N	22.80	14.34	0.20	13.58	60.00	50.00	-23.42	-21.88

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y) = \pm 1.2$dB Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence

Notes:

5.1.3 Sample Calculation

The signal strength is calculated by adding the LISN Correction Factor and Cable Loss to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{FIM} + \text{CBL} + \text{LCF}$$

Where: FIM = Field Intensity Meter (dBμV)
CBL = Cable Loss (dB)
LCF = LISN Loss (dB)

$$\mu\text{V/m} = 10^{\frac{dB\mu V/m}{20}}$$

6 Test Equipment Use List

6.1 Test Equipment use list

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
SOP 1 - Radiated Emissions (5 Meter Chamber)					
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	30-Jan-08	30-Jan-09
Antenna Horn 1-18GHz	EMCO	3115	5770	16-Jun-08	16-Jun-10
Ant. BiconiLog	Chase	CBL6140A	1108	13-Jun-08	13-Jun-10
Receiver, EMI	Rohde & Schwarz	ESIB40	100043	9-Jun-08	9-Jun-09
Cable, Coax	Andrew	FSJ1-50A	003	25-Jan-08	25-Jan-09
Cable, Coax	Andrew	FSJ1-50A	030	30-Jan-08	30-Jan-09
Cable, Coax	Andrew	FSJ1-50A	045	30-Jan-08	30-Jan-09
SOP 2 - Conducted Emissions (AC/DC)					
LISN 15-18 (NSLK 8126)	Schwarzbeck Mess-Electronik	NSLK 8126	003885	11-Jan-08	11-Jan-09
Spectrum Analyzer[1]	Agilent Tec.	E7405A	US39440161	7-Aug-08	7-Aug-09
Cable, Coax	Belden	RG-213	004	25-Jan-08	25-Jan-09

Note:

1) This equipment was also used for antenna port conducted measurements.