ADDENDUM TO FC02-060

FOR THE

RAYLINK WHISP CARD

FCC PART 15 SUBPART C SECTION 15.247

COMPLIANCE

DATE OF ISSUE: AUGUST 9, 2002

PREPARED FOR:

Raylink, Incorporated
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PREPARED BY:

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W.O. No.: 79043

Date of test: June 3-9, 2002

Report No.: FC02-060A

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ADMINISTRATIVE INFORMATION

DATE OF TEST:	June 3-9, 2002
DATE OF RECEIPT:	June 3, 2002
PURPOSE OF TEST:	To demonstrate the compliance of the Raylink WHISP Card, with the requirements for FCC Part 15 Subpart C Section 15.247 devices. This report is for an FCC Permissive 2 Change. Changes to the system include the addition of two antenna types with gains of 14 dBi and 18 dBi. The purpose of Addendum A is to revise the peak output and fundamental readings.
TEST METHOD:	ANSI C63.4 (1992)
MANUFACTURER:	Raylink Incorporated 424A Cloverleaf Dr. Baldwin Park, CA 91706
REPRESENTATIVE:	Vincent Lin
TEST LOCATION:	CKC Laboratories, Inc. 110 Olinda Place Brea, CA 92621

SUMMARY OF RESULTS

As received, the Raylink Incorporated Raylink WHISP Card was found to be fully compliant with the following standards and specifications:

United States

- FCC Part 15 Subpart C Section 15.247
- ANSI C63.4 (1992) method

CONDITIONS FOR COMPLIANCE

No modifications to the EUT were necessary to comply.

APPROVALS

QUALITY ASSURANCE:

Steve Behm, Director of Engineering Services

Joyce Walker, Quality Assurance Administrative Manager

Septimiu Apahidean, EMC/Lab Manager

TEST PERSONNEL:

Eddie Wong, EMC Engineer

EQUIPMENT UNDER TEST (EUT) DESCRIPTION

The Outdoor ISM Band 2.4 GHz FHSS System tested by CKC Laboratories was representative of a production unit. Changes to the previously approved system include the addition of two antenna types with gains of 14 dBi and 18 dBi.

The Superpass 120° Sector panel antenna tested is considered worst case for the following antenna:

- Maxrad MSO24014PTNF 14 dbi sectorized omni(actually 3 14 dbi 120 degree sector antenna)
- Pacific Wireless PAWSA24-12 90 degree 12 dBi

The AntennasAmerica 18dbi panel antenna tested is considered worst case for the following panel directional antennas:

- Raylink 18 dbi and 12 dbi (these are identical to the YDI 12 dbi panel and YDI/Antennas-America 18 dbi panel respectively). These are connected directly to the radio card by MMS connector from Radial.
- Superpass SPFPG13 13 dbi panel antenna
- Superpass SPFPG15 15 dbi panel antenna
- Superpass SPFPG16 16 dbi panel antenna
- Superpass SPFPG18 18 dbi panel antenna

15.31(m) Number Of Channels
This device was tested on three channels.

15.33(a) Frequency Ranges Tested
15.247(c) Radiated Emissions: 1-25 GHz

15.205 Restricted Bands
The fundamental operating frequency lies outside the restricted bands and therefore complies with the requirements of Section 15.205 of the FCC rules. Any spurious emission coming from the EUT was investigated to determine if any portion lies inside the restricted band. If any portion of a spurious emissions signal was found to be within a restricted band, investigation was performed to ensure compliance with Section 15.209.

Eut Operating Frequency
The EUT was tested at 2402 MHz, 2441 MHz and 2480 MHz.
The EUT is a frequency hopping device operating in the 2400 – 2483.5 MHz band.

EQUIPMENT UNDER TEST

Outdoor ISM Band 2.4 GHz FHSS System

Manuf:	Raylink Incorporated
Model:	WHISP
Serial:	88A6ES
FCC ID:	PLBWHISP*

18 dbi Panel Antenna

Manuf:	AntennasAmerica
Model:	AAI-00084
Serial:	NA
FCC ID:	NA

120° Sector 14 dbi Panel Antenna

Manuf:	Superpass
Model:	SPDG112T
Serial:	NA
FCC ID:	NA

*This product was originally approved under FCC ID Number L39G689372 to Raytheon for indoor use only. It was re-certified under FCC ID Number PLBWHISP to Raylink Incorporated for outdoor use. Therefore, the FCC ID Number L39G689372 recorded during testing is for the same product with FCC ID Number PLBWHISP.

PERIPHERAL DEVICES

The EUT was tested with the following peripheral device(s):

Laptop

Manuf:	Texas Instrument
Model:	Travelmate 4000M
Serial:	171014D067X
FCC ID:	A92DMMAC

REPORT OF MEASUREMENTS

FCC Part 15.247(b)(1) Peak Output

The EUT conformed to requirement set forth by FCC 15.247 (b) with adjustment calculated in accordance with FCC 15.247 (b)(3) see attached

(b)1 The maximum peak power of the intentional radiator shall not exceed the following (1) For frequency hopping system in the 2400-2483.5 MHz: 1 Watt (30 dBm)

Power limit for Mode A (Multi point)
If Transmitting antenna of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated value in (b)(1) or (b)(2)as appropriate by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

30 dBm + 6 dB = 36 dBm= 3.98 Watts

Power limit for Mode B (Point to point)
Antenna gain = 18 dBi, Point to Point
Clause (I) : for point to point operation, may employ transmit antenna with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.:

18 dB – 6 dB = 12 dB.
30dBm +18 dB –(12 dB/ 3) = 44 dBm = 25.1 Watts

Equivalent Isotropic Radiated Power
EIRP obtained by calculation.
EIRP = Measured Conducted power at antenna port + antenna gain

Mode A : Antenna gain = 14 dBi

Frequency	EIRP	Limit	
2402 MHz	2.35 Watts	3.98 Watts	Pass
2441 MHz	2.83 Watts	3.98 Watts	Pass
2480 MHz	2.14 Watts	3.98 Watts	Pass

Mode B : Antenna gain = 18 dBi

Frequency	EIRP	Limit	
2402 MHz	5.90 Watts	25.1 Watts	Pass
2441 MHz	7.09 Watts	25.1 Watts	Pass
2480 MHz	5.38 Watts	2.51 Watts	Pass

Conducted Power

The EUT conformed to requirement set forth by FCC 15.247 (b) with adjustment calculated in accordance with FCC 15.247 (b)(3) see attached

Power limit for Mode A (Multi point)
30 dBm – 8 dB = 22 dBm= 129 dBuV=0.1585 Watts

Power limit for Mode B (Point to point)
30dBm –12 dB/ 3 = 26 dBm = 133 dBuV= 0.3981 Watts

Conducted power was measured directly at the antenna port of the EUT.

Mode A

Frequency	Measured Peak power	Limit	
2402 MHz	0.0853 Watt	0.1585 Watt	Pass
2441 MHz	0.1125 Watt	0.1585 Watt	Pass
2480 MHz	0.0935 Watt	0.1585 Watt	Pass

Mode B

Frequency	Measured Peak Power	Limit	
2402 MHz	0.0853 Watt	0.3981 Watt	Pass
2441 MHz	0.1125 Watt	0.3981 Watt	Pass
2480 MHz	0.0935 Watt	0.3981 Watt	Pass

dBm to watts conversion

$$\text{dBm} = 10\text{LOG}\frac{\text{Power}}{1\text{x}10^{-3}}$$

$$\text{Power(Watts)} = 1\text{x}10^{-3}\text{antiLog}\frac{\text{dBm}}{10}$$

dBuV to Power Conversion

$$V = 1\,\text{x}\,10^{-6}\ \text{x}\ 10^{\frac{\text{dBuV}}{20}}$$

$$\text{Power} = \frac{V^2}{R}$$

The following tables report the six highest worst case levels recorded during the tests performed on the Raylink WHISP Card. All readings taken are peak readings unless otherwise noted. The data sheets from which these tables were compiled are contained in Appendix B.

Table 1: 15.247(b)(1) Fundamental Emission Levels

FREQUENCY MHz	METER READING dBµV	CORRECTION FACTORS Ant dB	dB	dB	dB	CORRECTED READING dBµV/m	SPEC LIMIT dBµV/m	MARGIN dB	NOTES
2401.850	126.3	0.0				126.3	129.0	-2.7	A
2401.850	126.3	0.0				126.3	133.0	-6.7	B
2440.850	127.5	0.0				127.5	129.0	-1.5	A
2440.850	127.5	0.0				127.5	133.0	-5.5	B
2479.850	126.7	0.0				126.7	129.0	-2.3	B
2479.850	126.7	0.0				126.7	133.0	-6.3	B

Test Method: ANSI C63.4 (1992)
Spec Limit: FCC Part 15 Subpart C Section 15.247(b)(1)
Test Distance: None

NOTES: A = Mode A
B = Mode B

COMMENTS: The EUT was placed on the test bench and the antenna cable was connected to the Antenna. Support laptop runs DOS base program to exercise the EUT Limit: Mode A (Multi point) = 22 dBm = 129 dBuV, 110 Vac, 60 Hz, 20°C, 54% relative humidity. Mode B (Point to point) = 26 dBm = 133 dBuV, 110 Vac, 60 Hz, 20°C, 54% relative humidity.

FCC Part 15.247(b)(3) Directional Gain Reduction

The maximum peak power of the intentional radiator shall not exceed the following (1) For frequency hopping system in the 2400-2483.5 MHz: 1 Watt

If transmitting antenna of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated value in (b)(1) or (b)(2) as appropriate by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

1 Watt = 10 Log (1 / 3 e-3) = 30 dBm

Mode A
Antenna gain = 14 dBi, Multi- Point
14 dBi – 6 dB = 8 dB

Power limit for Mode A
30 dBm – 8 dB = **22 dBm**= 129 dBuV

Mode B
Antenna gain = 18 dBi, Point to Point
Clause (i) : for point to point operation, may employ transmit antenna with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.:

18 dB – 6 dB = 12 dB.

Power limit for Mode B (Point to point)
30dBm –12 dB/3 = **26 dBm** = 133 dBuV

Table 2: 15.247(c)/15.209 Six Highest Radiated Emission Levels									
	METER	CORRECTION FACTORS				CORRECTED	SPEC		
FREQUENCY MHz	READING dBµV	Ant dB	Amp dB	Cable dB	Filter dB	READING dBµV/m	LIMIT dBµV/m	MARGIN dB	NOTES
4803.656	50.9	32.8	-37.2	6.2	0.7	53.4	54.0	-0.6	VA
4803.730	50.7	32.8	-37.2	6.2	0.7	53.2	54.0	-0.8	VA
4881.685	49.8	32.9	-37.2	6.3	0.8	52.6	54.0	-1.4	VA
7322.750	47.5	36.0	-37.8	8.1	0.0	53.8	54.0	-0.2	VA
7322.750	43.0	36.0	-37.8	8.1	4.1	53.4	54.0	-0.6	HA
7439.500	46.3	36.1	-37.9	8.1	0.0	52.6	54.0	-1.4	V

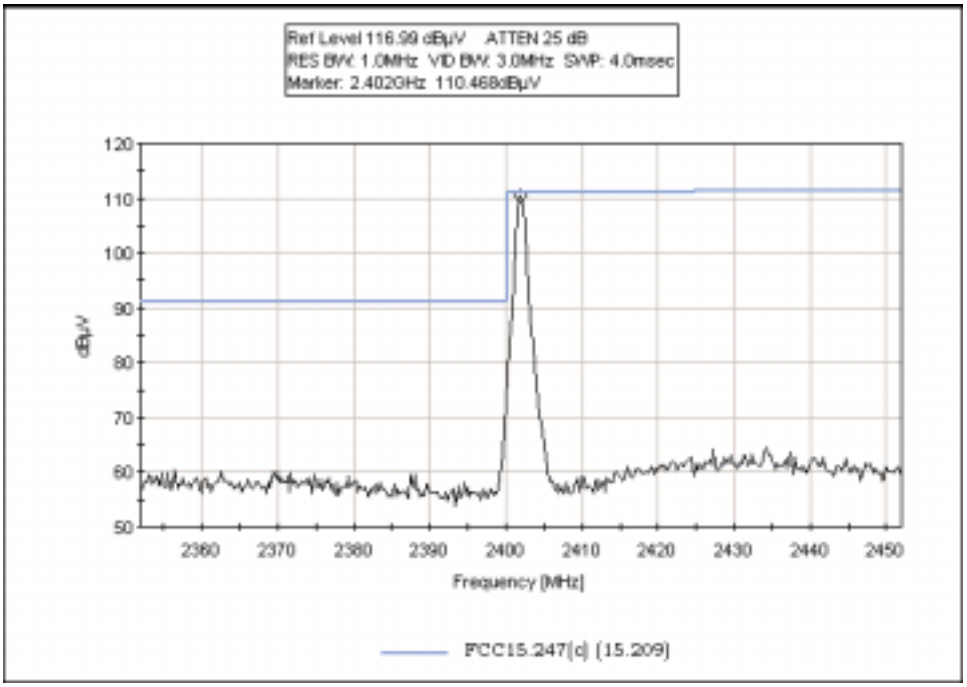
Test Method: ANSI C63.4 (1992)
Spec Limit: FCC Part 15 Subpart C Section 15.247(c)/15.209
Test Distance: 3 Meters

NOTES: H = Horizontal Polarization
V = Vertical Polarization
A = Average Reading

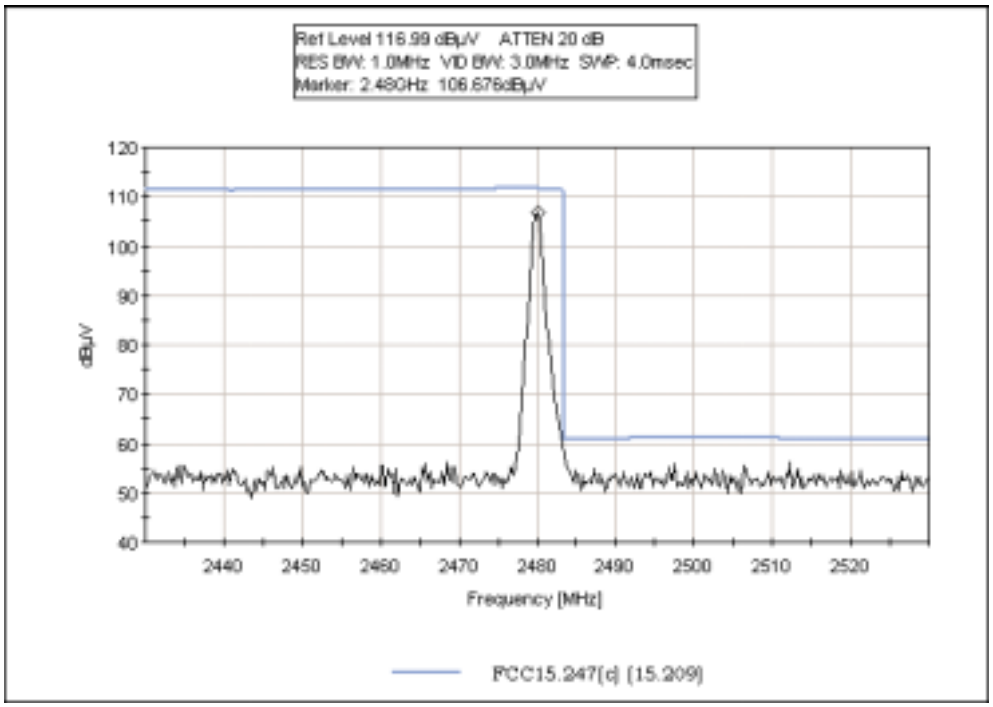
COMMENTS: The EUT was placed on the test bench and the antenna cable was connected to the Antenna. Support laptop runs DOS base program to exercise the EUT. Mode A: 14 dBi gain antenna. Range of measurement: 1 - 25 GHz. RBW=VBW=1 MHz. Channel: Low = 2402 MHz, Channel: Mid = 2441 MHz, Channel: Hi = 2480 MHz. 110 Vac, 60 Hz, 20°C, 54% relative humidity. Note: Measurement of fundamental and harmonics. Mode B, 18 dBi Gain antenna. Range of measurement: 1 - 25 GHz. RBW=VBW=1 MHz. Channel: Low = 2402 MHz, Channel: Mid = 2441 MHz, Channel: Hi = 2480 MHz.

FCC Part 15.247(c) Bandedge Plots

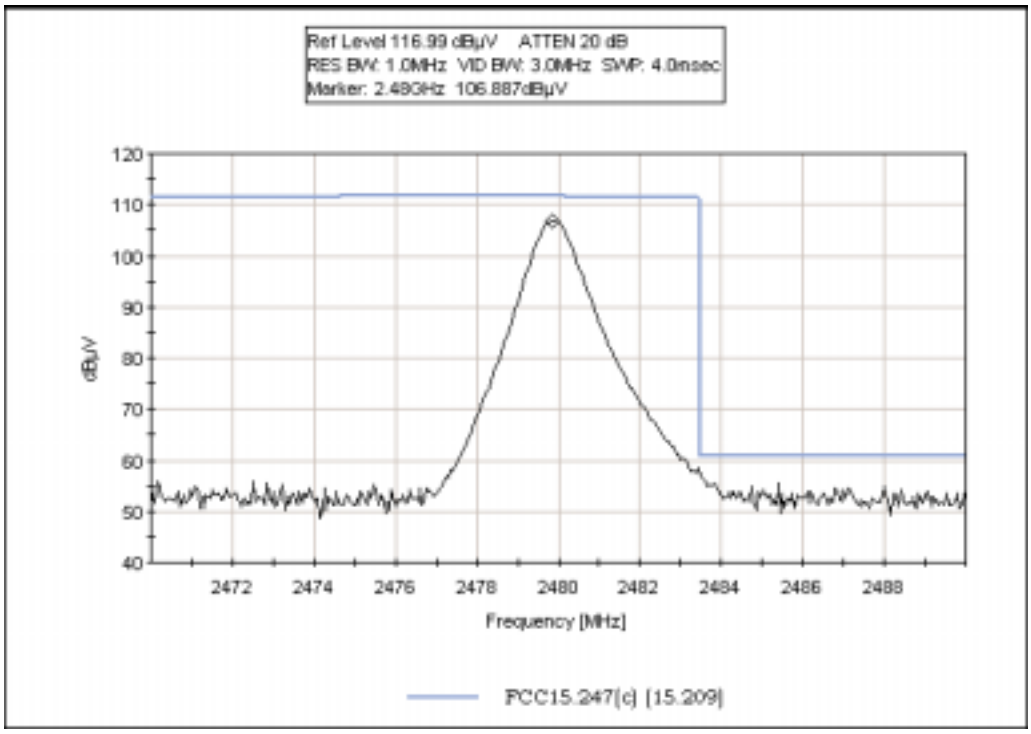
Bandedge - Low - Mode A



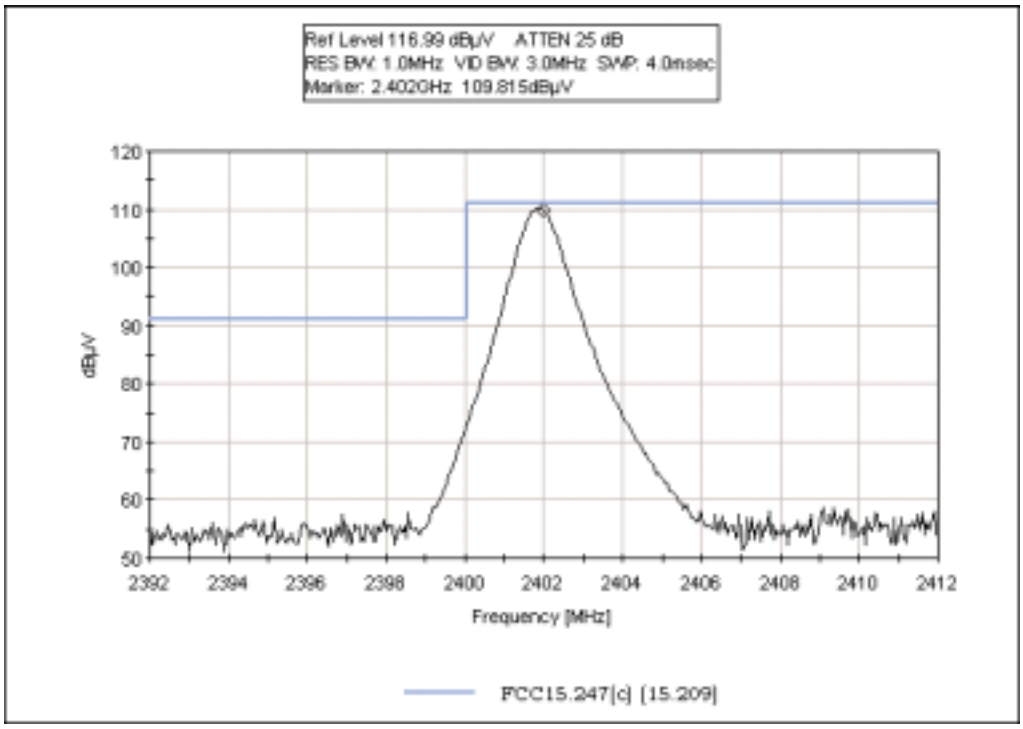
Bandedge - High - Mode A



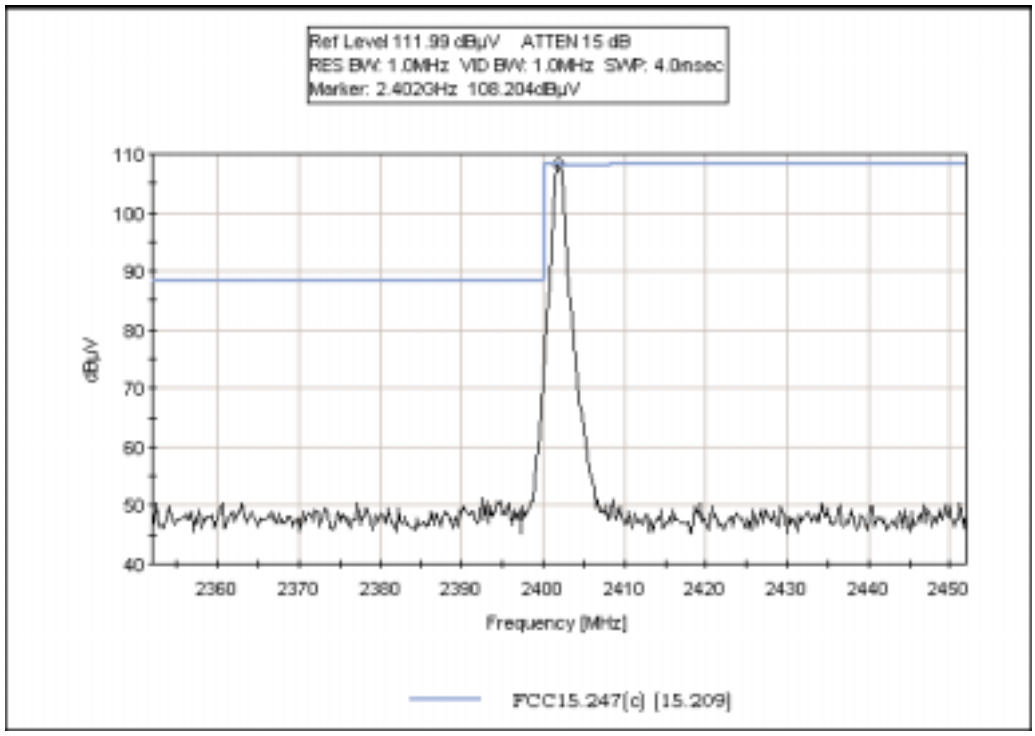
Bandedge - High - 20 MHz Span - Mode A



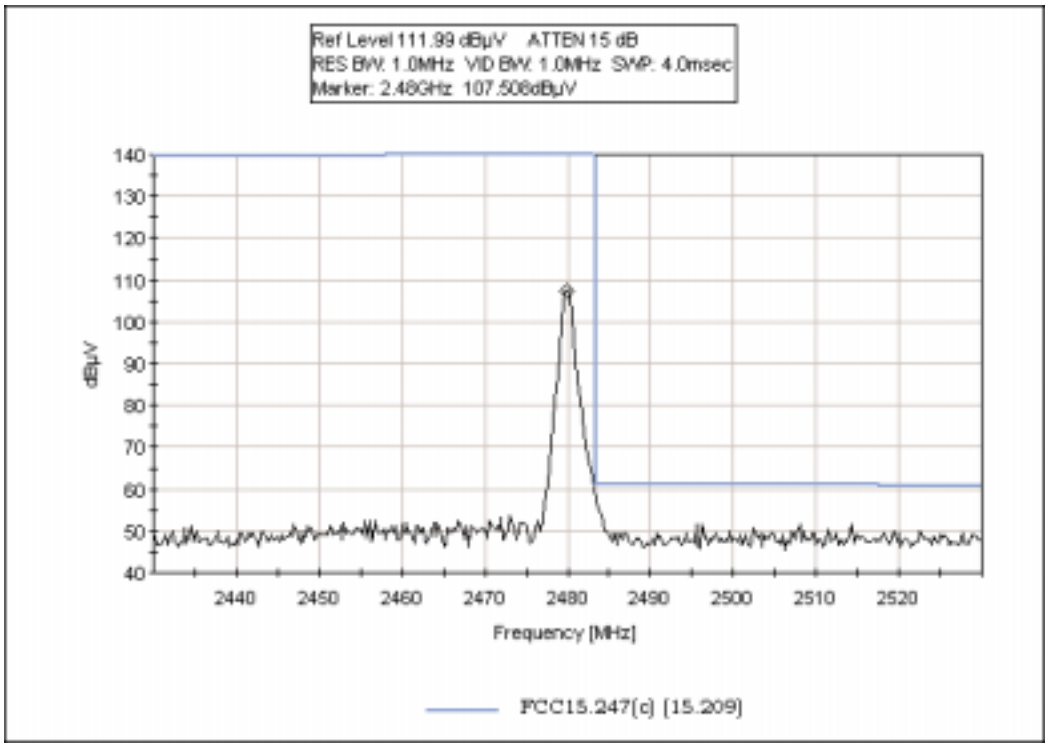
Bandedge - High - 20 MHz Span - Mode A



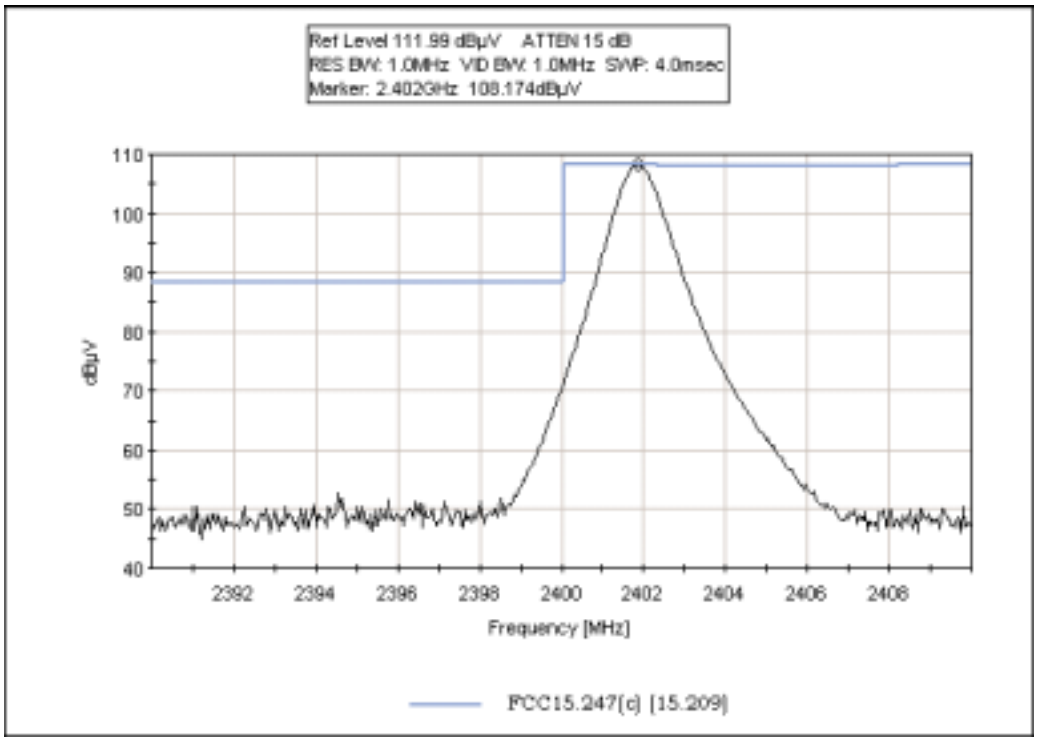
Bandedge - Low - Mode B



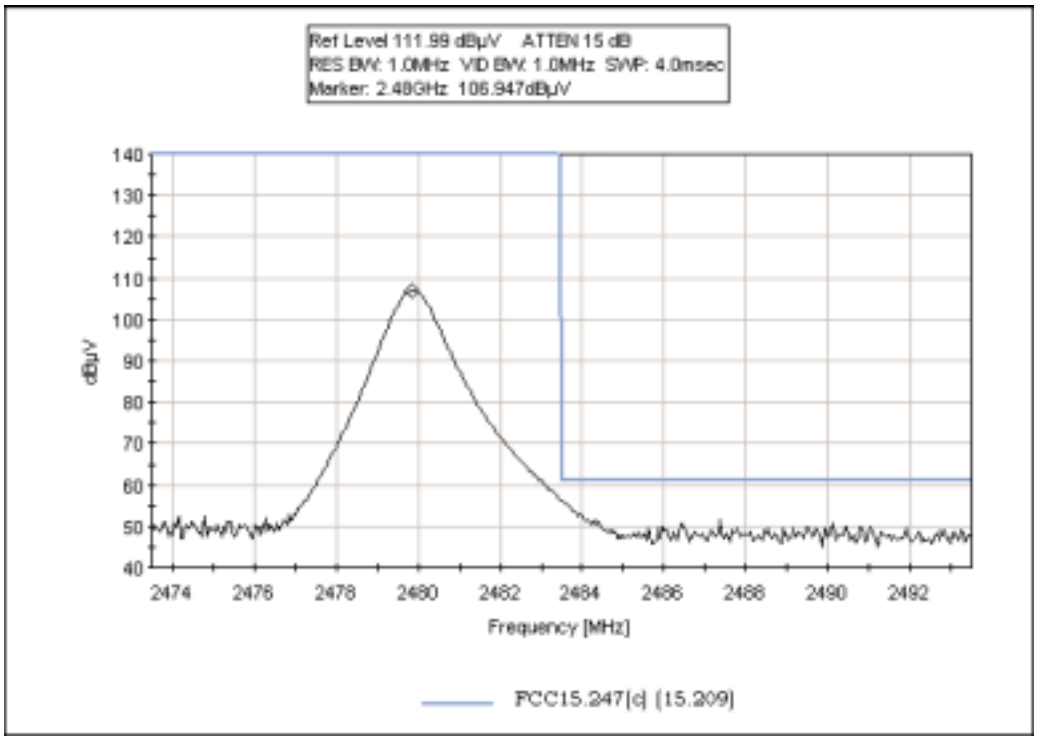
Bandedge - High - Mode B



Bandedge - Low - 20 MHz Span - Mode B



Bandedge - High - 20 MHz Span - Mode B



MEASUREMENT UNCERTAINTY
Measurement uncertainty associated with data in this report is a ± 2.94dB for radiated emissions.

EUT SETUP
The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the photographs in Appendix A. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables. The corrected data was then compared to the applicable emission limits to determine compliance.

The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available I/O ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. I/O cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The radiated emissions data of the Raylink WHISP Card, was taken with the HP Spectrum Analyzer. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in Table A.

Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS
The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula in Table A. This reading was then compared to the applicable specification limit to determine compliance.

TABLE A: SAMPLE CALCULATIONS

	Meter reading	(dBµV)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed in Table A were used to collect both the radiated emissions data for the Raylink WHISP Card. The horn antenna was used for frequencies above 1000 MHz. All antennas were located at a distance of 3 meters from the edge of the EUT.

The HP spectrum analyzer was used for all measurements. Table B shows the analyzer bandwidth settings that were used in designated frequency bands. During radiated testing, the measurements were made with 0 dB of attenuation, a reference level of 97 dBµV, and a vertical scale of 10 dB per division.

FCC SECTION 15.35:
TABLE B: ANALYZER BANDWIDTH SETTINGS PER FREQUENCY RANGE

TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
RADIATED EMISSIONS	1000 MHz	25 GHz	1 MHz

SPECTRUM ANALYZER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the Tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "Peak" mode. Whenever a "Quasi-Peak" or "Average" reading is listed as one of the six highest readings, this is indicated as a "Q" or an "A" in the appropriate table. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data for the Raylink WHISP Card.

Peak

In this mode, the Spectrum Analyzer or test engineer recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature of the analyzer called "peak hold," the analyzer had the ability to measure transients or low duty cycle transient emission peak levels. In this mode the analyzer made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

When the true peak values exceeded or were within 2 dB of the specification limit, quasi-peak measurements were taken using the HP Quasi-Peak Adapter for the HP Spectrum Analyzer. The detailed procedure for making quasi peak measurements contained in the HP Quasi-Peak Adapter manual were followed.

Average
For certain frequencies, average measurements may be made using the spectrum analyzer. To make these measurements, the test engineer reduces the video bandwidth on the analyzer until the modulation of the signal is filtered out. At this point the analyzer is set into the linear mode and the scan time is reduced.

EUT TESTING

Antenna Conducted Emissions
For measuring the signal strength on the RF output port of the EUT, the spectrum analyzer was connected directly to the EUT. The sweep time of the analyzer was adjusted so that the spectrum analyzer readings were always in a calibrated range. All readings within 20 dB of the limit were recorded.

Radiated Emissions
The EUT was mounted on a nonconductive, rotating table 80 cm above the conductive grid. The nonconductive table dimensions were 1 meter by 1.5 meters.

During the preliminary radiated scan, the EUT was powered up and operating in its defined FCC test mode. For frequencies exceeding 1000 MHz, the horn antenna was used. Care was taken to ensure that no frequencies were missed within the FM and TV bands. An analysis was performed to determine if the signals that were at or near the limit were caused by an ambient transmission. If unable to determine by analysis, the equipment was powered down to make the final determination if the EUT was the source of the emission.

A thorough scan of all frequencies was made manually using a small frequency span, rotating the turntable as needed. The test engineer maximized the readings with respect to the table rotation and configuration of EUT. Maximizing of the EUT was achieved by monitoring the spectrum analyzer on a closed circuit television monitor.

TRANSMITTER CHARACTERISTICS

15.247(b) Peak Output Power
Frequency of Transmitter: 2400-2483.5 MHz

The RF conducted test was measured using a direct connection between the antenna port of the transmitter and the spectrum analyzer, through suitable attenuation. The resolution bandwidth was adjusted to greater than the 6 dB bandwidth of the emissions.

- **15.247(b)(1)** The maximum peak output power of frequency hopping systems operating in the 2400-2483.5 band and for all direct sequences, shall not exceed 1 watt.

APPENDIX A

TEST SETUP PHOTOGRAPHS

Direct Connect Test Setup

Direct Connect Test Setup - Modes A&B

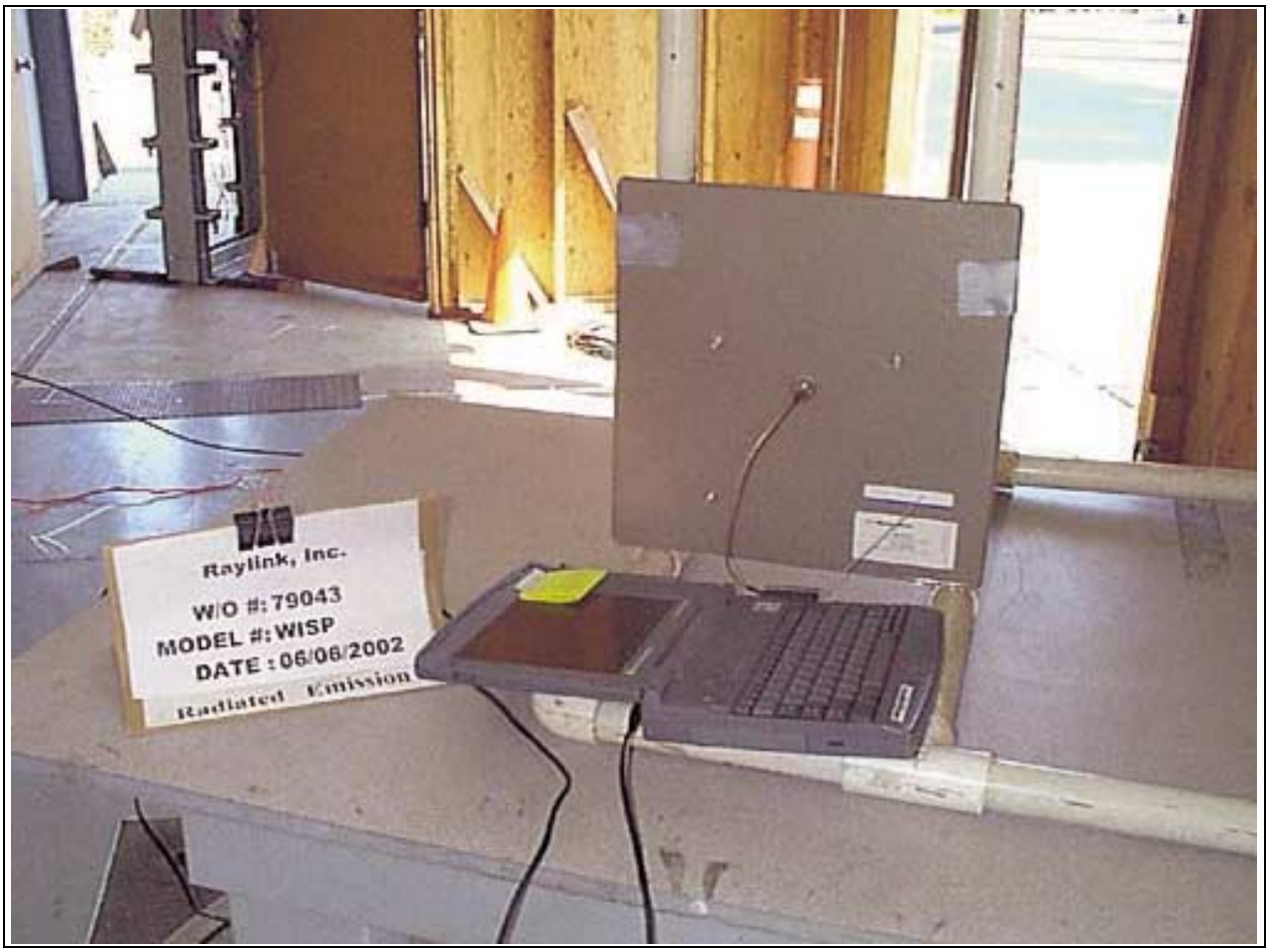
OATS Test Setup - Mode A

OATS Test Setup - Front View - Biconilog Antenna - Mode A

OATS Test Setup

OATS Test Setup - Back View - Biconilog Antenna - Mode A

OATS Test Setup - Mode B



OATS Test Setup - Front View - Biconilog Antenna - Mode B

OATS Test Setup

OATS Test Setup - Back View - Biconilog - Mode B

OATS Test Setup - Mode A

OATS Test Setup - Front View - Horn Antenna - Mode A

OATS Test Setup - Mode B

OATS Test Setup - Front View - Horn Antenna - Mode B

OATS Test Setup

OATS Test Setup - Front View - Horn Antenna

APPENDIX B

TEST EQUIPMENT LIST

OATS Emissions FCC 15.247(b)(1), FCC 15.247(c), FCC15.205

Equipment	Asset #	Manufacturer	Model #	Serial #	Cal Date	Cal Due
Spectrum Analyzer	02467	Agilent	E7405A	US40240225	032902	032903
1-18GHz						
Horn Antenna	0849	EMCO	3115	6246	091201	091202
Microwave Pre-amp	00786	HP	83017A	3123A00281	091201	091202
¼" Heliax Coaxial Cable	NA	Andrew	LDF1-50	Cable#18 (70 ft)	091101	091102
2.4 GHz HPF	HP	01440	NA	NA	100301	100302
18-25 GHz						
Horn antenna	HP	02112	8412580008	961178006	070901	070902

ERP						
Spectrum Analyzer	02467	Agilent	E7405A	US40240225	032902	032903
Horn Antenna	0849	EMCO	3115	6246	091201	091202
Microwave Pre-amp	00786	HP	83017A	3123A00281	091201	091202
¼" Heliax Coaxial Cable	NA	Andrew	LDF1-50	Cable#18 (70 ft)	091101	091102
Antenna cable (25)	NA	Andrew	FSJ1-50A	Cable#13	071701	071702
Sig gen	02559	Gigatronics	1026	272810	052802	052803
Power Amp	02160	AR	10S1G4A	24375	092702	092703
Horn Antenna	01646	EMCO	3115	9603-4683	031902	031903

Antenna Terminal FCC 15.247(b)(1)

Equipment	Asset #	Manufacturer	Model #	Serial #	Cal Date	Cal Due
Spectrum Analyzer	02467	Agilent	E7405A	US40240225	032902	032903

APPENDIX C

MEASUREMENT DATA SHEETS

Test Location: CKC Laboratories, Inc. •110 N. Olinda Place • Brea, CA 92823 • (714) 993-6112

Customer:	**Raylink, Inc.**		
Specification:	**15.247(b)(1) (Mode A)**		
Work Order #:	**79043**	Date:	06/03/2002
Test Type:	**Conducted Emissions**	Time:	10:22:26
Equipment:	**Outdoor ISM Band 2.4 GHz FHSS System**	Sequence#:	1
Manufacturer:	Raylink, Inc.	Tested By:	Eddie Wong
Model:	WISP		120V 60Hz
S/N:	88A6ES		

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Outdoor ISM Band 2.4 GHz FHSS System*	Raylink, Inc.	WISP	88A6ES

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Texas Instrument	Travelmate 4000M	171014D067X

Test Conditions / Notes:

EUT placed on the test bench, antenna cable is connected to the Antenna. Support laptop runs DOS base program to exercise the EUT Limit : Mode A (Multi point) = 22 dBm = 129 dBuV. 110 Vac, 60 Hz, 20°C, 54% relative humidity.

Transducer Legend:

Measurement Data: Reading listed by margin. Test Lead: Antenna Terminal

#	Freq MHz	Rdng dBµV	dB	dB	dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2440.850M	127.5					+0.0	127.5	129.0	-1.5	Anten
2	2479.850M	126.7					+0.0	126.7	129.0	-2.3	Anten
3	2401.850M	126.3					+0.0	126.3	129.0	-2.7	Anten

Test Location: CKC Laboratories, Inc. •110 N. Olinda Place • Brea, CA 92823 • (714) 993-6112

Customer:	**Raylink, Inc.**		
Specification:	**15.247(b)(1) (Mode B)**		
Work Order #:	**79043**	Date:	06/03/2002
Test Type:	**Conducted Emissions**	Time:	10:22:26
Equipment:	**Outdoor ISM Band 2.4 GHz FHSS System**	Sequence#:	1
Manufacturer:	Raylink, Inc.	Tested By:	Eddie Wong
Model:	WISP		120V 60Hz
S/N:	88A6ES		

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Outdoor ISM Band 2.4 GHz FHSS System*	Raylink, Inc.	WISP	88A6ES

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Texas Instrument	Travelmate 4000M	171014D067X

Test Conditions / Notes:

EUT placed on the test bench, antenna cable is connected to the Antenna. Support laptop runs DOS base program to exercise the EUT Limit : Mode B (Point to point) = 26 dBm = 133 dBuV. 110 Vac, 60 Hz, 20°C, 54% relative humidity.

Transducer Legend:

Measurement Data: Reading listed by margin. Test Lead: Antenna Terminal

#	Freq MHz	Rdng dBµV	dB	dB	dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2440.850M	127.5					+0.0	127.5	133.0	-5.5	Anten
2	2479.850M	126.7					+0.0	126.7	133.0	-6.3	Anten
3	2401.850M	126.3					+0.0	126.3	133.0	-6.7	Anten

Test Location: CKC Laboratories, Inc. •110 N. Olinda Place • Brea, CA 92823 • (714) 993-6112

Customer: **Raylink Incorporated**
Specification: **FCC 15.247 (c) (FCC 15.209) 2480 MHz**
Work Order #: **79043** Date: 06/06/2002
Test Type: **Maximized emission** Time: 17:34:13
Equipment: **Outdoor ISM Band 2.4 GHz FHSS System** Sequence#: 4
Manufacturer: Raylink Incorporated Tested By: Eddie Wong
Model: WHISP
S/N: 88A6ES

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Outdoor ISM Band 2.4 GHz FHSS System*	Raylink Incorporated	WHISP	88A6ES

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Texas Instrument	Travelmate 4000M	171014D067X

Test Conditions / Notes:

The EUT was placed on the test bench and the antenna cable was connected to the Antenna. Support laptop runs DOS base program to exercise the EUT. Mode A: 14 dBi gain antenna. Range of measurement: 1 - 25 GHz. RBW=VBW=1 MHz. Channel: Low = 2402 MHz, Channel: Mid = 2441 MHz, Channel: Hi = 2480 MHz. 110 Vac, 60 Hz, 20°C, 54% relative humidity. Note: Measurement of fundamental and harmonics.

Transducer Legend:

T1=Horn Antenna sn6246	T2=Heliax #18 70' 11Sept2001
T3=HP3017A sn3123A00281 11-Sept-01	T4=HPF 2.4GHz High Pass

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2402.000M	128.1	+27.7	+4.1	-38.8	+0.0	+0.0	121.1	121.1 Fundamental	+0.0	Vert
2	2479.800M	127.9	+27.7	+4.1	-38.8	+0.0	+0.0	120.9	120.9 Fundamental	+0.0	Vert
3	2440.930M	128.6	+27.6	+4.2	-38.5	+0.0	+0.0	121.9	121.9 Fundamental	+0.0	Vert
4	7322.750M Ave	47.5	+36.0	+8.1	-37.8	+0.0	+0.0	53.8	54.0 Harmonics of 2441MHz	-0.2	Vert
^	7322.750M	50.2	+36.0	+8.1	-37.8	+0.0	+0.0	56.5	54.0 Harmonics of 2441MHz	+2.5	Vert
6	4803.656M Ave	50.9	+32.8	+6.2	-37.2	+0.7	+0.0	53.4	54.0 Harmonics of 2402 MHz	-0.6	Vert
^	4803.656M	53.9	+32.8	+6.2	-37.2	+0.0	+0.0	56.4	54.0 Harmonics of 2402 MHz	+2.4	Vert

8	7439.500M	46.3	+36.1	+8.1	-37.9	+0.0	+0.0	52.6	54.0	-1.4	Vert harmonics of 2480 MHz
9	4881.750M Ave	50.1	+32.9	+6.3	-37.2	+0.0	+0.0	52.1	54.0	-1.9	Vert Harmonics of 2441MHz
^	4881.750M	52.3	+32.9	+6.3	-37.2	+0.0	+0.0	54.3	54.0	+0.3	Vert Harmonics of 2441MHz
11	4803.656M Ave	48.4	+32.8	+6.2	-37.2	+0.7	+0.0	50.9	54.0	-3.1	Horiz Harmonics of 2402 MHz
^	4803.656M	50.5	+32.8	+6.2	-37.2	+0.7	+0.0	53.0	54.0	-1.0	Horiz Harmonics of 2402 MHz
13	4959.700M Ave	48.2	+33.0	+6.3	-37.2	+0.0	+0.0	50.3	54.0	-3.7	Vert harmonics of 2480 MHz
^	4959.700M	50.7	+33.0	+6.3	-37.2	+0.0	+0.0	52.8	54.0	-1.2	Vert harmonics of 2480 MHz
15	7439.580M	43.9	+36.1	+8.1	-37.9	+0.0	+0.0	50.2	54.0	-3.8	Horiz harmonics of 2480 MHz
16	4881.750M	48.1	+32.9	+6.3	-37.2	+0.0	+0.0	50.1	54.0	-3.9	Horiz Harmonics of 2441MHz
17	7439.700M Ave	42.1	+36.1	+8.1	-37.9	+0.0	+0.0	48.4	54.0	-5.6	Vert harmonics of 2480 MHz
18	4959.580M	45.1	+33.0	+6.3	-37.2	+0.0	+0.0	47.2	54.0	-6.8	Horiz harmonics of 2480 MHz
19	7439.600M	39.9	+36.1	+8.1	-37.9	+0.0	+0.0	46.2	54.0	-7.8	Horiz harmonics of 2480 MHz
20	7322.750M Ave	39.5	+36.0	+8.1	-37.8	+0.0	+0.0	45.8	54.0	-8.2	Horiz Harmonics of 2441MHz
^	7322.708M	45.2	+36.0	+8.1	-37.8	+0.0	+0.0	51.5	54.0	-2.5	Horiz Harmonics of 2441MHz
22	7205.580M	51.1	+35.8	+8.0	-37.7	+3.3	+0.0	60.5	101.1	-40.6	Vert Harmonics of 2402 MHz
23	7205.580M	49.0	+35.8	+8.0	-37.7	+3.3	+0.0	58.4	101.1	-42.7	Horiz Harmonics of 2402 MHz
24	9607.580M	38.8	+37.4	+9.4	-41.6	+3.3	+0.0	47.3	101.1	-53.8	Vert Harmonics of 2402 MHz

Test Location: CKC Laboratories, Inc. •110 N. Olinda Place • Brea, CA 92823 • (714) 993-6112

Customer:	**Raylink Incorporated**		
Specification:	**FCC 15.247 (c) (FCC 15.209) 2480 MHz**		
Work Order #:	**79043**	Date:	06/06/2002
Test Type:	**Maximized emission**	Time:	15:38:57
Equipment:	**Outdoor ISM Band 2.4 GHz FHSS System**	Sequence#:	3
Manufacturer:	Raylink Incorporated	Tested By:	Eddie Wong
Model:	WHISP		
S/N:	88A6ES		

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Outdoor ISM Band 2.4 GHz FHSS System*	Raylink Incorporated	WHISP	88A6ES

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Texas Instrument	Travelmate 4000M	171014D067X

Test Conditions / Notes:

The EUT was placed on the test bench and the antenna cable was connected to the Antenna. Support laptop runs DOS base program to exercise the EUT. Mode B, 18 dBi Gain antenna. Range of measurement: 1 - 25 GHz. RBW=VBW=1 MHz. Channel: Low = 2402 MHz, Channel: Mid = 2441 MHz, Channel: Hi = 2480 MHz. 110 Vac, 60 Hz, 20°C, 54% relative humidity. Note: Measurement of fundamental and harmonics.

Transducer Legend:

T1=Horn Antenna sn6246	T2=Heliax #18 70' 11Sept2001
T3=HP3017A sn3123A00281 11-Sept-01	T4=HPF 2.4GHz High Pass
T5=10' Silver Semflex SMA CKC P1403	

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2479.990M	128.6	+27.7 +0.0	+4.1	-38.8	+0.0	+0.0	121.6	121.6 Fundamental	+0.0	Vert
2	2440.850M	129.2	+27.6 +0.0	+4.2	-38.5	+0.0	+0.0	122.5	122.5 Fundamental	+0.0	Vert
3	2401.850M	129.3	+27.5	+4.3	-38.3		+0.0	122.8	122.8 Fundamental	+0.0	Vert

4	7322.750M Ave	43.0	+36.0 +0.0	+8.1	-37.8	+4.1	+0.0	53.4	54.0	-0.6	Horiz VBw=10Hz, Harmonics of 2441 MHz, Hopping 2441MHz & 2480MHz, CISPR11 Formula applied.
^	7322.750M	50.0	+36.0 +0.0	+8.1	-37.8	+4.1	+0.0	60.4	54.0	+6.4	Horiz Harmonics of 2441 MHz, Hopping 2441MHz & 2480MHz
^	7322.750M	48.9	+36.0 +0.0	+8.1	-37.8	+4.1	+0.0	59.3	54.0	+5.3	Horiz Harmonics of 2441MHz
7	4803.730M Ave	50.7	+32.8 +0.0	+6.2	-37.2	+0.7	+0.0	53.2	54.0	-0.8	Vert Harmonics of 2402 MHz
^	4803.730M	53.7	+32.8 +0.0	+6.2	-37.2	+0.7	+0.0	56.2	54.0	+2.2	Vert Harmonics of 2402 MHz
9	4881.685M Ave	49.8	+32.9 +0.0	+6.3	-37.2	+0.8	+0.0	52.6	54.0	-1.4	Vert Harmonics of 2441MHz
^	4881.685M	51.9	+32.9 +0.0	+6.3	-37.2	+0.8	+0.0	54.7	54.0	+0.7	Vert Harmonics of 2441MHz
11	7323.000M Ave	41.9	+36.0 +0.0	+8.1	-37.8	+4.1	+0.0	52.3	54.0	-1.7	Vert VBW=10Hz, Harmonics of 2441 MHz, Hopping 2441MHz & 2480MHz,CISPR11 Formula applied.
^	7323.000M	48.0	+36.0 +0.0	+8.1	-37.8	+4.1	+0.0	58.4	54.0	+4.4	Vert Harmonics of 2441 MHz, Hopping 2441MHz & 2480MHz
13	4959.600M	49.0	+33.0 +0.0	+6.3	-37.2	+0.9	+0.0	52.0	54.0	-2.0	Vert Harmonics of 2480 MHz

14	7439.500M Ave	40.5	+36.1 +0.0	+8.1	-37.9	+5.0	+0.0	51.8	54.0	-2.2	Horiz VBW=10Hz,Harmonics of 2480 MHz, Hopping 2441MHz & 2480MHz, CISPR11, DA00-705 Correction
^	7439.500M	51.2	+36.1 +0.0	+8.1	-37.9	+5.0	+0.0	62.5	54.0	+8.5	Horiz Harmonics of 2480 MHz, Hopping 2441MHz & 2480MHz
^	7439.500M	47.8	+36.1 +0.0	+8.1	-37.9	+5.0	+0.0	59.1	54.0	+5.1	Horiz Harmonics of 2480 MHz
17	7439.500M Ave	40.2	+36.1 +0.0	+8.1	-37.9	+5.0	+0.0	51.5	54.0	-2.5	Vert VBW=10Hz,Harmonics of 2480 MHz, Hopping 2441MHz & 2480MHz,CISPR11 Formula , DA00-705 Correction
^	7439.500M	51.1	+36.1 +0.0	+8.1	-37.9	+5.0	+0.0	62.4	54.0	+8.4	Vert Harmonics of 2480 MHz, Hopping 2441MHz & 2480MHz
^	7439.500M	48.1	+36.1 +0.0	+8.1	-37.9	+5.0	+0.0	59.4	54.0	+5.4	Vert Harmonics of 2480 MHz
20	4881.530M	47.5	+32.9 +0.0	+6.3	-37.2	+0.8	+0.0	50.3	54.0	-3.7	Horiz Harmonics of 2441MHz
21	4803.675M Ave	47.2	+32.8 +0.0	+6.2	-37.2	+0.7	+0.0	49.7	54.0	-4.3	Horiz Harmonics of 2402 MHz
^	4803.675M	49.6	+32.8 +0.0	+6.2	-37.2	+0.7	+0.0	52.1	54.0	-1.9	Horiz Harmonics of 2402 MHz
23	4959.600M	46.2	+33.0 +0.0	+6.3	-37.2	+0.9	+0.0	49.2	54.0	-4.8	Horiz Harmonics of 2480 MHz
24	7323.850M	35.8	+36.0 +0.0	+8.1	-37.8	+4.1	+0.0	46.2	54.0	-7.8	Horiz Noise floor.
25	7323.000M Ave	34.0	+36.0 +0.0	+8.1	-37.8	+4.1	+0.0	44.4	54.0	-9.6	Vert Video Averaging Harmonics of 2441 MHz, Hopping & 2441MHz to 2480MHz

26	9919.500M	35.6	+37.5 +0.0	+9.8	-41.6	+3.5	+0.0	44.8	101.6	-56.8	Horiz Harmonics of 2480 MHz
27	9763.630M	36.3	+37.5 +0.0	+9.6	-41.6	+3.4	+0.0	45.2	102.5	-57.3	Horiz Harmonics of 2441MHz
28	9607.730M	37.0	+37.4 +0.0	+9.4	-41.6	+3.3	+0.0	45.5	102.8	-57.3	Vert Harmonics of 2402 MHz
29	9763.529M	35.0	+37.5 +0.0	+9.6	-41.6	+3.4	+0.0	43.9	102.5	-58.6	Vert Harmonics of 2441MHz