UTStarcom Canada

Raven iPA 800 Bi-Directional Amplifier

Report of Measurements

as per

FCC CFR47 Part 15/B and FCC CFR47 Part 22/H

Revision 0.1

May 12, 2005

Approval		
Checked By:	**Robert Stirling, P.Eng**	**Date**

Protocol Labs, Abbotsford BC, Canada
FCC Registration Number 96437
Industry Canada Registration Numbers IC3384

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Section I: Information for Test Report of Measurements

Testing Details

TESTED BY: David Johanson

TEST CONDITIONS: Temperature and Humidity: 10.8° C, 62%

TEST VOLTAGE: 120Vac, 60Hz

Test Facilities

Protocol Labs
28945 McTavish Rd.
Abbotsford BC, Canada, V4X 2E7

FCC Registration Number 96437
Industry Canada Registration Number IC3384

Test Equipment List

EMISSIONS:

Device	Model Number	Serial No.	Last Cal.	Next Cal
Antenna	EMCO LPA-30	178	13/10/04	13/10/05
Antenna	EMCO EM 6912	380	11/10/04	11/010/05
Antenna	EMCO EM 3105/3115	2024	25/02/05	25/02/06
LISN	Solar 8012-50-R-24-BNC	863092	22/10/04	22/10/05
Spectrum Analyzer with Quasi-Peak and Preselector	HP 8566B/85650A/85685A	2241A02102/ 2318A05184/ 2043A00240/ 3107A01222	22/03/05	22/03/06
Tower	Rhientech Labs	Custom	NR	NR
Turntable	Protocol	Custom	NR	NR
Spectrum Analyzer	Agilent E4440A	MY44303399	01/01/05	01/01/06
Signal Generator	Agilent E4433B	GB40051228	30/06/05	30/06/07
Signal Generator	Agilent E4437B	MY41000126	07/01/05	07/01/07
Temperature Chamber	Custom	Custom	NR	NR
Multimeter	Fluke 87 III True RMS	76670030	27/02/04	27/02/06
Variable Power Supply	Elgar 1201EL/4	20621	NR	NR

Company Tested For

NAME:	UTStarcom Canada
ADDRESS:	4600 Jacombs Road Richmond, BC V6V 3B1
CONTACT PERSON:	Mr. Joe Perrella
PHONE NUMBER:	604-276-0055

Company on Test Site

NAME:	Unity Wireless Systems Corporation
ADDRESS:	7438 Fraser Park Drive Burnaby, BC V5J 5B9
CONTACT PERSON:	Mr. Rami Kenig
EMAIL:	ramik@unitywireless.com
PHONE NUMBER:	604-267-2737

Equipment Under Test

THE TEST SYSTEM:	EUT:	Bi-Directional Amplifier iPA 800
	Manufacturer:	Unity Wireless Systems Corporation, OEM UTStarcom Canada
	Part Number:	300 0001 003
	Serial Number:	05030677
	Aux Equip 1:	Signal Generator
	Manufacturer:	Agilent
	Part Number:	E4437B
	Serial Number:	MY41000126
	Aux Equip 2:	Laptop PC
	Manufacturer:	Toshiba
	Part Number:	PS22SC-N91J4
	Serial Number:	60013470

TEST SETUP: The EUT was setup in its approved operating configuration as per the requested requirements of the manufacturer.

CABLING:

Cable	Connector	Load/Termination	Shielded	Ferrites
RG58	N Male	50 Ohm Load	Yes	No
RG174	SMA Male	Frequancy Generator	Yes	No
RG6	N Male	Attenuators/Spectrum Analyzer	Yes	No
Power Cord	3 Prong AC Plug	120VAC	No	No
RS-232 Serial	DB-9 male	PC Serial Port	Yes	No

MODIFICATIONS: No modifications were required for this unit to pass.

CONCLUSION: The Raven iPA 800 Amplifier that was tested complies with the requirements of FCC CFR47 Part 15/B, and FCC CFR47 Part 22H

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Section II: FCC CFR47 Part 15/B Report of Measurements

General

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15B - Unintentional Radiators, Class A.

Both the Radiated and Power Line Conducted Emission tests were performed using measurement procedure outlined in the above standard.

FCC Labeling and Marking Requirements:

Markings

According to FCC Section 15.19, and ICES 003, a statement similar to the following must be included on an identification label, which also uniquely identifies the manufactured date, either explicitly or through a serial number etc.:

> "This equipment complies with FCC Rules, Part 15 and Industry Canada's ICES 003 for a Class A Digital Device. Operation is subject to two conditions:
>
> 1) This device may not cause harmful interference, and
> 2) This device must accept any interference that may cause any undesired operation"

Additionally, if the manufacturer markets product to Quebec, the following supplemental information should be added to the label:

> "Cet Apparreil numerique de la Classe A respecte toutes les exigences du Reglement sur le material broilleur du Canada."

Labeling

According to FCC Section 15.105, and ICES 003, the following statement must be included in a prominent location your User's Manual:

> NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

It is also required according to FCC Part B Section 15.21 that a caution is included such as:

> Caution: Changes or modifications to this equipment, not expressly approved by the manufacturer could void the user's authority to operate the equipment.

Part 1 - Conducted Emission Testing

DATE: April 20, 2005

TEST STANDARD: FCC CFR47, Part 15, Subpart B

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: The EUT was connected to the conducted emissions LISN apparatus.

MINIMUM STANDARD: Class A Limit:

Frequency (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 - 0.50	79	66
5.00 - 30.0	73	60

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer, Peak detector. Any emissions that are close to the limit Are measured using a test receiver and CISPR Quasi-Peak detector.

DEVICE DESCRIPTIONS: As described in the Equipment Under Test Section, above.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLING:

Cable	Connector	Load/Termination	Shielded	Ferrites
RG58	N Male	50 Ohm Load	Yes	No
RG174	SMA Male	Frequency Generator	Yes	No
RG6	N Male	Attenuators/Spectrum Analyzer	Yes	No
Power Cord	3 Prong AC Plug	120VAC	No	No
RS-232 Serial	DB-9 male	PC Serial Port	Yes	No

MODIFICATIONS: No modifications were required for the device to pass the test.

MEASUREMENT DATA: See Appendix B for Plots,

EMISSIONS DATA: See Tables 1 and 2 in Appendix B for corresponding frequencies.

PERFORMANCE: Complies with standard.

Part 2 - Radiated Emission Testing

DATE: April 20, 2005

TEST STANDARD: FCC CFR47, Part 15, Subpart B

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: Although this test calls for measurements to be performed at 10-meters, this EUT radiates so few frequencies and at such low levels that the equipment was set up in a 3-meter open field test site. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions signal strength and the results recorded on the attached plots and compensated to indicate the equivalent level if the signals were measured at 10-meters.

MINIMUM STANDARD: Class A Limit:

Frequency MHz	Field Strength at 10m	
	Microvolts/Meter	dB microvolts per meter
30 - 88	90	39.08
88 - 216	150	43.52
216 - 960	210	46.44
960 - above	300	49.54

DEVICE DESCRIPTIONS: Refer to the Equipment Under Test Section.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLING:

Cable	Connector	Load/Termination	Shielded	Ferrites
RG58	N Male	50 Ohm Load	Yes	No
RG174	SMA Male	Frequency Generator	Yes	No
RG6	N Male	Attenuators/Spectrum Analyzer	Yes	No
Power Cord	3 Prong AC Plug	120VAC	No	No
RS-232 Serial	DB-9 male	PC Serial Port	Yes	No

MODIFICATIONS: No modifications were required for the device to pass the test.

EMISSIONS DATA: See Table in Appendix B for corresponding frequencies.

PERFORMANCE: Complies with standard.

Section III: FCC CFR47 Part 22H Report of Measurements

General

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 22H – Cellular Radiotelephone Service.

The Radiated Emission tests were performed using measurement procedure outlined in the above standard and in the applicable parts of CFR47 Part 2.

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Part 1 - Field Strength of Spurious Radiation measurements

DATE: April 20, 2005

TEST STANDARD: 47CFR2.1053, 22.901(d),22.917(e)

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: As required by §2.1053, field strength of spurious radiation measurements were made in accordance with the general procedures of ANSI C63.4-1992 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz". The final measurements were made on a 3-meter open area test site. The unit was scanned over the frequency range of 9 kHz to 20 GHz.

The EUT was connected to the appropriate generators, terminators and a laptop PC. The RF output was set to 42.3 dBm (17Watts) as per the manufacturers tuning procedures.

MINIMUM STANDARD: As per 22.917(e), the spurious emissions must be attenuated by:
43 + 10log(P) below the transmitting power level.
The power level for this test was set at: 17W

Therefore, the attenuation level limit for spurious emissions is set at:
55.3dBm

The field strength limit is calculated by using the plane wave relation at 3m:
Emissions less then 1GHz E = √(49.2x17)/3 = 151.82dBμV/m

Attenuation level = 151.8 – 55.3 = 96.5dBμV

Emissions greater then 1GHz E = 151.82 – 20Log√(1.64) = 149.7dBμV/m

Attenuation level = 149.7 – 55.3 = 94.4dBμV

MODIFICATIONS: No modifications were required for the device to pass the test.

EMISSIONS DATA: See the following pages for the data.

PERFORMANCE: Complies with standard.

Carrier Emission: 17 watts; Fundamental of 881.4900MHz; CDMA-IS95 Modulated signal

Frequency	Ant. Pol	Ant. Hgt	Ang	Uncor-Pk	Tot Corr	Test distance	Corrected Peak	Limit	Margin
(MHz)		(m)	(deg)	(dBμV)	(dB)	(m)	(dBμV/m)	(dBμV)	(dB)
62.30091	V	1	30	10.2	6.27	3	16.47	94.4	87.93
240.5485	H	2.5	0	7.0	13.87	3	20.87	94.4	73.53

No Radiated Emissions were observed between 881.49 and 9GHz

Correction Factor = Antenna Factor + Cable Loss – Preamplifier Gain + Distance Correction

Part 2 – Occupied Bandwidth

DATE: April 29, 2005

TEST STANDARD: FCC CFR47, Part 2.1049

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: As required by §2.1049 of CFR 47, occupied bandwidth measurements were made on the Amplifier pre- and post- Amplifier. A digital signal generator was configured to transmit a CDMA IS-95 modulated carrier signal. Using an IF bandwidth of 30kHz, we determined the occupied bandwidth of the emission at the lowest and highest selectable channel range was determined.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLING:

Cable	Connector	Load/Termination	Shielded	Ferrites
RG58	N Male	50 Ohm Load	Yes	No
RG174	SMA Male	Frequency Generator	Yes	No
RG6	N Male	Attenuators/Spectrum Analyzer	Yes	No
Power Cord	3 Prong AC Plug	120VAC	No	No
RS-232 Serial	DB-9 male	PC Serial Port	Yes	No

MODIFICATIONS: No modifications were required for the device to pass the test.

EMISSIONS DATA: See the following pages for the Plots.

PERFORMANCE: Complies with standard.

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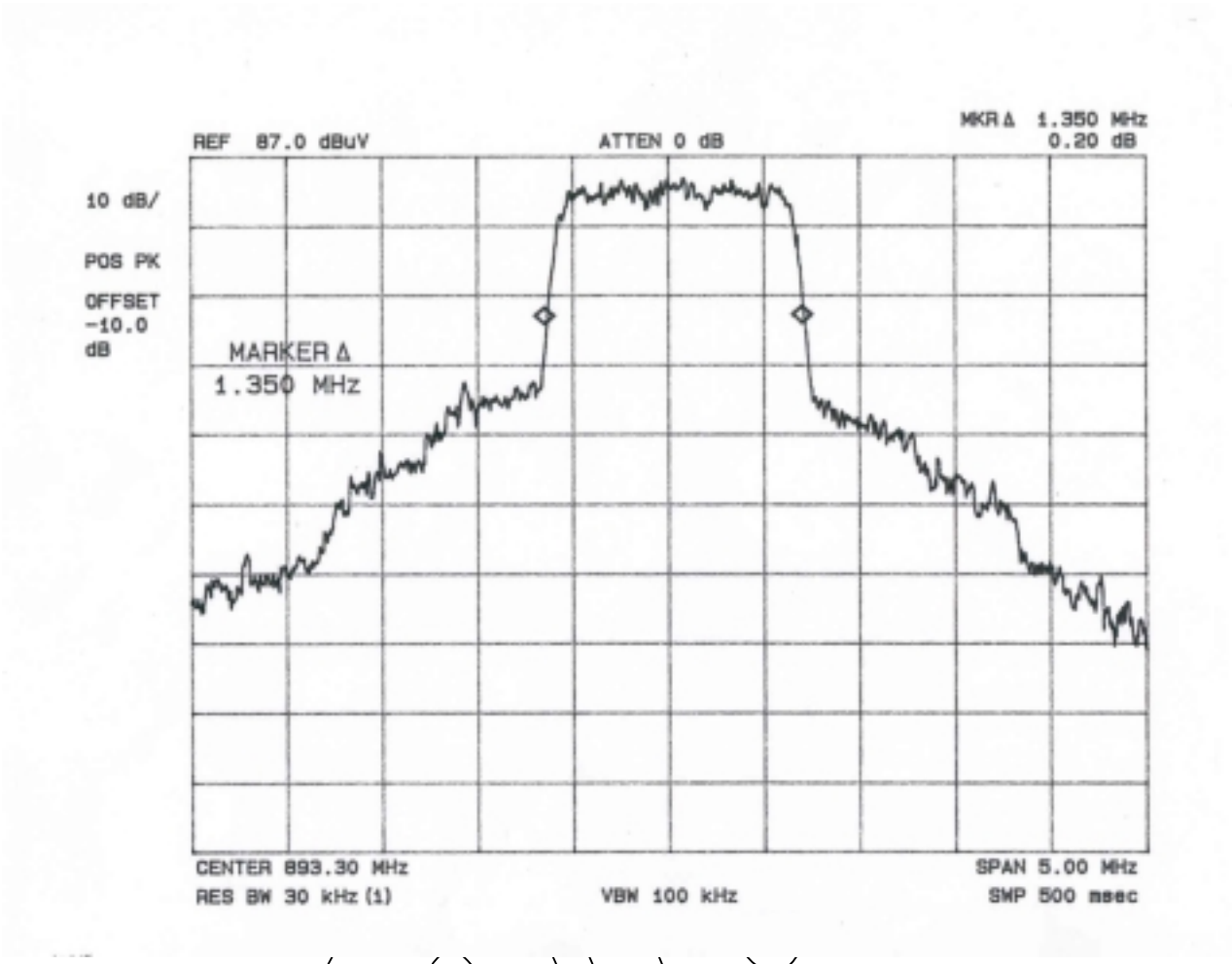
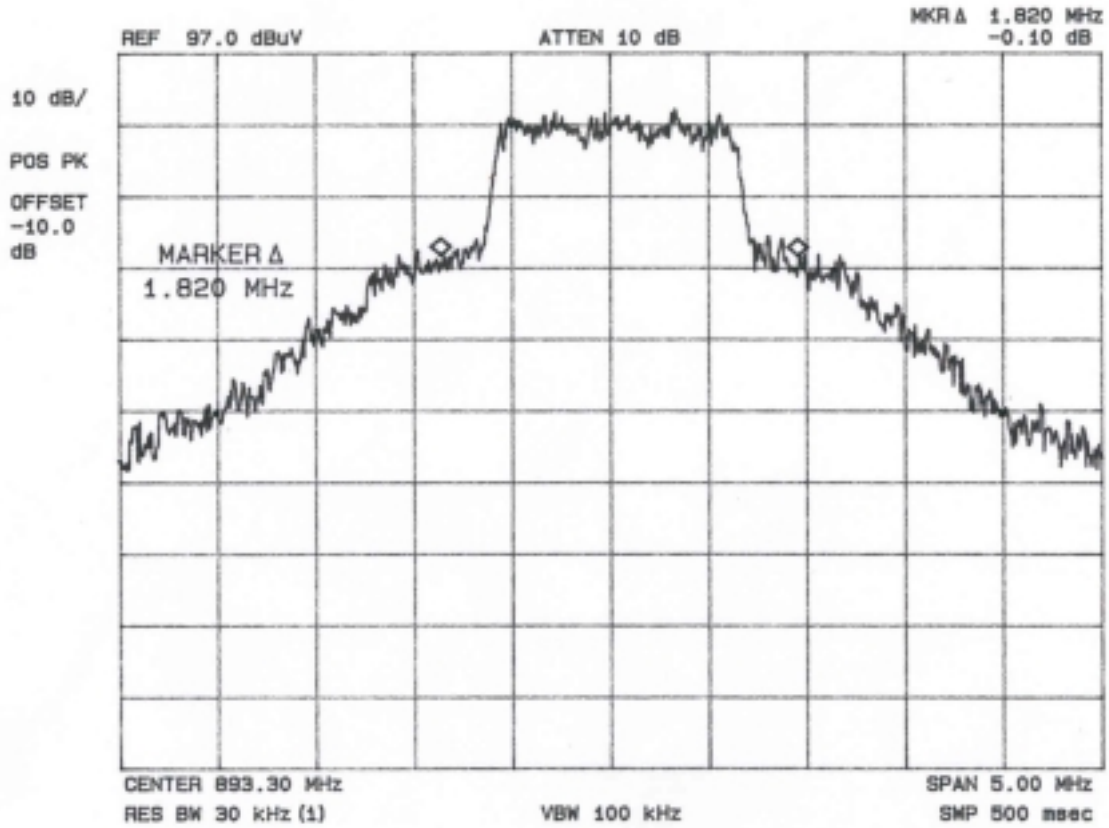


Occupied Bandwidth CDMA - Input side of Amplifier



Occupied Bandwidth CDMA - Output side of Amplifier

Part 3 – RF Power Output

DATE: April 21, 2005

TEST STANDARD: FCC CFR47, Part 2.1046 and 22.913(a)

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: As required by §2.1046 of CFR 47, *RF Power Output measurements* were made at the RF output terminals using a 50dB Attenuator and spectrum analyzer. This test was performed with a digital signal generator configured to transmit a CDMA IS-95 modulated carrier signal.

The EUT is programmed by a PC to operate on a selected single input and output channel. The input frequency must be on the programmed channel and near the required input level of 0dBm for the EUT to operate its transmitter. The amplifier is set to amplify the input signal by 42.3 dB to transmit at 42.3dBm (17Watts). The output frequency and power level can be slightly adjusted by the frequency and level of the input signal. The EUT is programmed to automatically shut down the transmitter if the output level exceeds 45.2dBm (33Watts). The output levels were measured at 3 frequencies and at the maximum level before the system turned off the RF output.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLING:

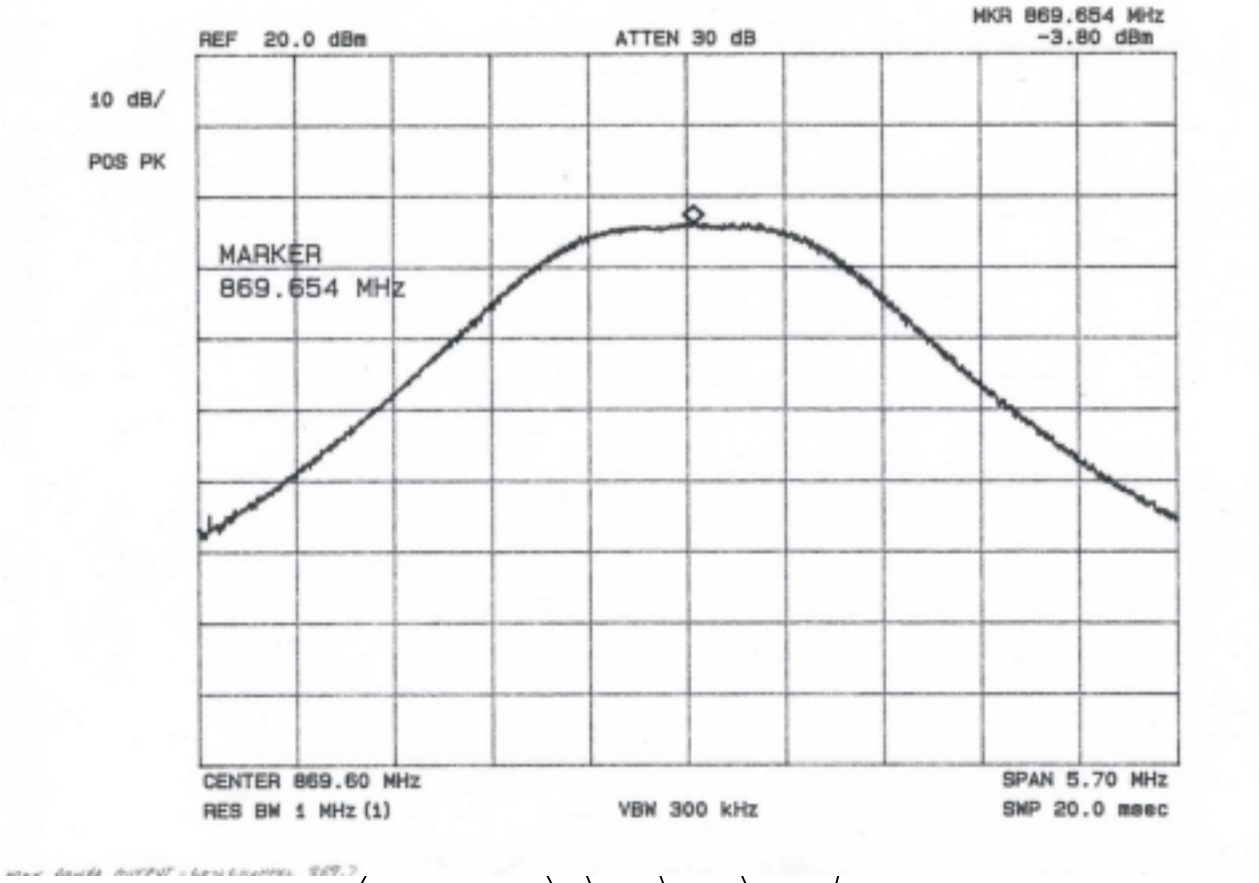
Cable	Connector	Load/Termination	Shielded	Ferrites
RG58	N Male	50 Ohm Load	Yes	No
RG174	SMA Male	Frequency Generator	Yes	No
RG6	N Male	Attenuators/Spectrum Analyzer	Yes	No
Power Cord	3 Prong AC Plug	120VAC	No	No
RS-232 Serial	DB-9 male	PC Serial Port	Yes	No

MODIFICATIONS: No modifications were required for the device to pass the test.

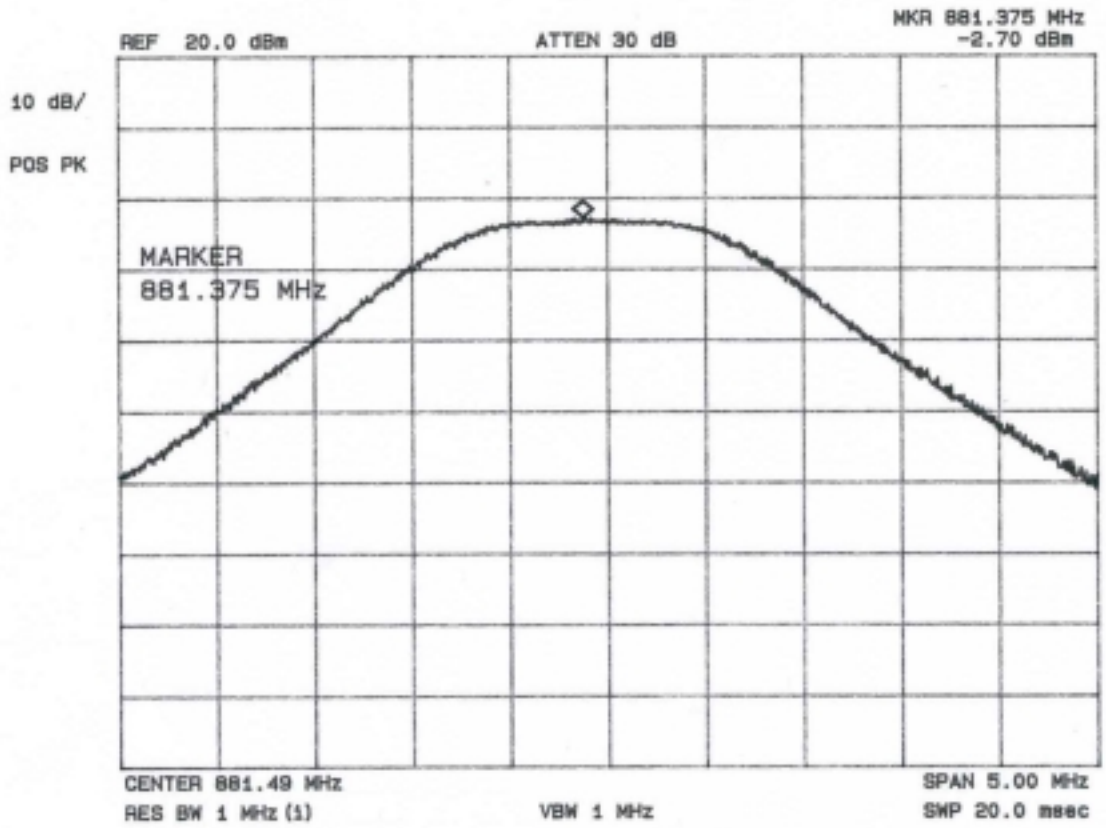
EMISSIONS DATA:

Frequency (MHz)	Output level (dBm)	Measured (dBm)	Correction (dB)	Total (dBm)	Total (W)
869.700	45.2	-3.80	51.3	47.5	56.23
881.490	45.2	-2.70	51.3	48.6	72.44
893.370	45.2	-2.60	51.3	48.7	74.13

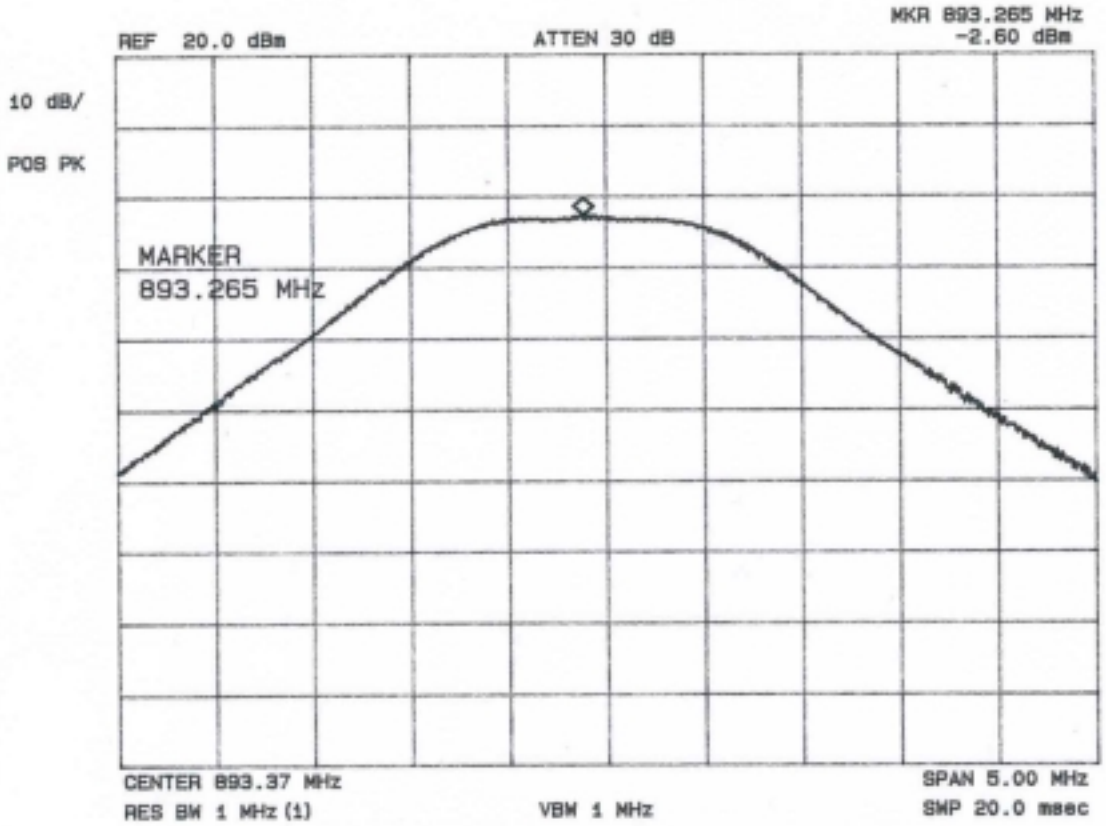
PERFORMANCE: Maximum output power level measured: 48.7dBm (74.13Watts)
Refer to plots on attached pages.



Maximum output power at Terminal
869.70 MHz



Maximum output power at Terminal
881.49 MHz



Max Power output

Maximum output power at Terminal
893.370 MHz

Part 4 – Spurious Emissions at Antenna Terminals

DATE: May 02, 2005

TEST STANDARD: FCC CFR47, Part 2.1051; 22.917(e)

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: As required by §2.1051 of CFR 47, spurious emissions at antenna terminal measurements were made at the RF output terminals using a 50 Ohm attenuator and spectrum analyzer set for a 1MHz bandwidth. Tests were also performed at 10kHz bandwidth to confirm frequency presence. This test was performed with a digital signal generator configured to transmit a CDMA IS-95 modulated carrier signal. The frequency spectrum was investigated from 9.0 kHz to 9.0 GHz.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLING:

Cable	Connector	Load/Termination	Shielded	Ferrites
RG58	N Male	50 Ohm Load	Yes	No
RG174	SMA Male	Frequency Generator	Yes	No
RG6	N Male	Attenuators/Spectrum Analyzer	Yes	No
Power Cord	3 Prong AC Plug	120VAC	No	No
RS-232 Serial	DB-9 male	PC Serial Port	Yes	No

MODIFICATIONS: No modifications were required for the device to pass the test.

STANDARD: The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice of more then twice the fundamental emission by at least:
(43 +10logP) = (43 + 10Log74.13) = 61.7dB
Limit line is: 48.7dBm – 61.7dB = -13dBm = 94.0dBμV

EMISSIONS DATA: See the following pages for the data.

PERFORMANCE: Complies with standard.

Low Channel 869.70 MHz set to 3.10dBm to produce 42.3dBm output.
(Measured while signal is modulated with CDMA – IS95)

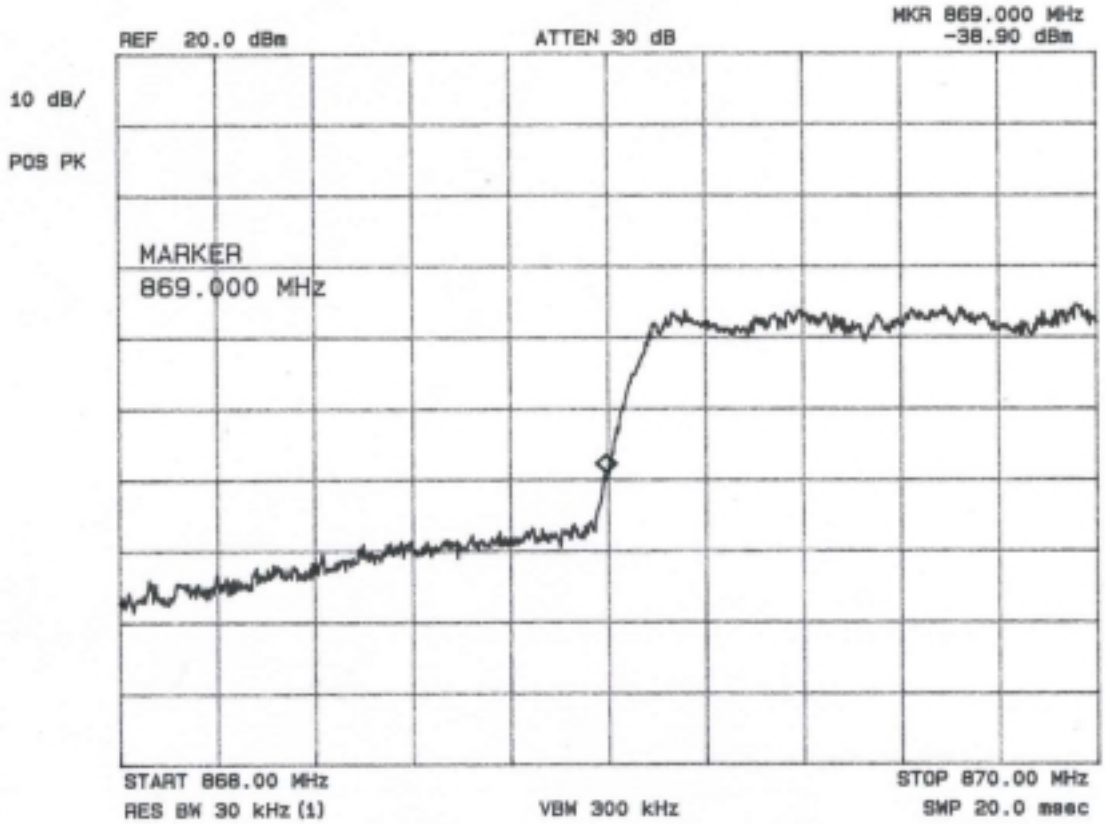
Frequency (MHz)	Harmonic	Measured Signal (dBμV) @ 30kHz RBW	Limit Lines dBm)	Delta Limit Peak (dBc)
869.6959	1st	149	N/A	NA
1739.399	2nd	45.2	93	47.8
2609.098	3rd	29.6	93	63.4
3478.799	4th	40.1	93	52.9
4348.499	5th	59.2	93	33.8
5218.199	6th	33.6	93	59.4
6087.900	7th	74.7	93	18.3
6957.595	8th	53.5	93	39.5
7827.298	9th	33.2	93	59.8
8696.997	10th	84.5	93	8.5

Mid Channel 881.490.MHz set to 1.96dBm to produce 42.3dBm output.
(Measured while signal is modulated with CDMA – IS95)

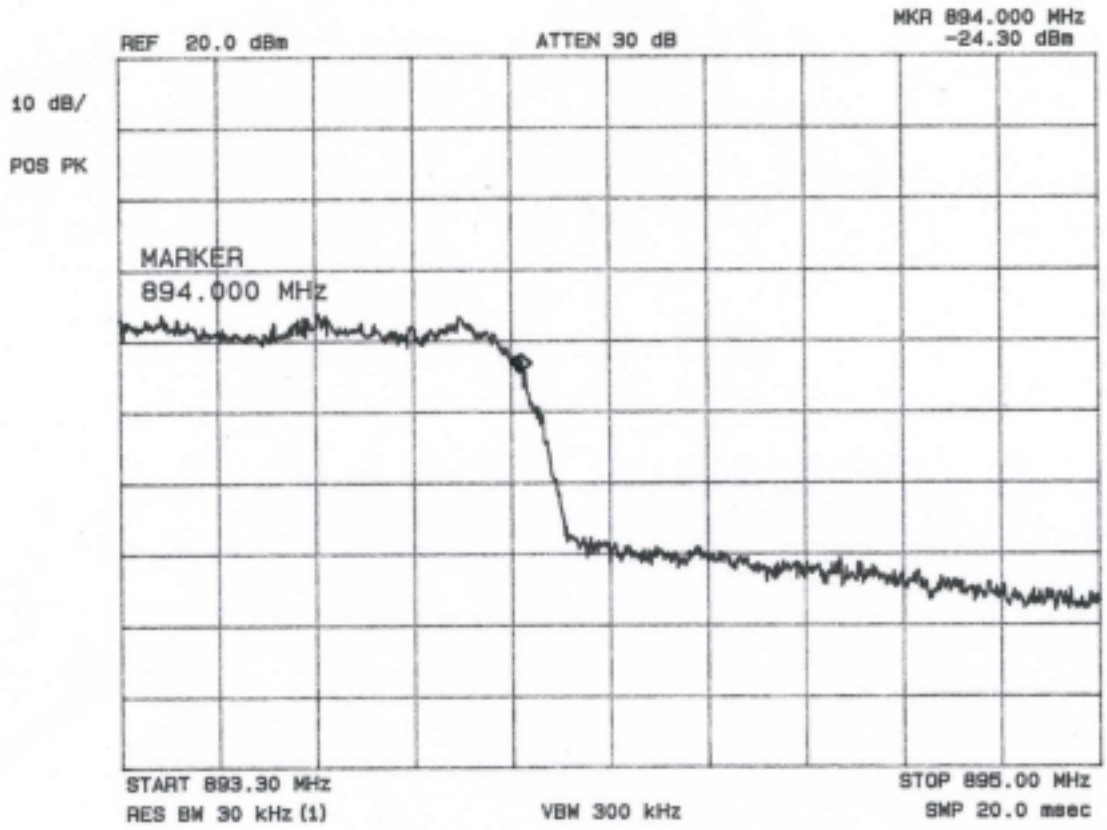
Frequency (MHz)	Harmonic	Measured Signal (dBμV) @ 30kHz RBW	Limit Lines dBm)	Delta Limit Peak (dBc)
881.4875	1st	150.4	N/A	NA
1762.989	2nd	50.2	93	53.35
2644.471	3rd	25.4	93	45.32
3525.952	4th	39.7	93	54.30
4407.449	5th	59.2	93	55.45
5288.947	6th	33.4	93	54.23
6170.421	7th	74.6	93	53.51
7051.912	8th	51.5	93	55.56
7933.399	9th	33.3	93	53.54
8814.901	10th	83.6	93	54.12

High Channel 893.370 MHz set to 42.3dBm output. Modulated with CDMA – IS95

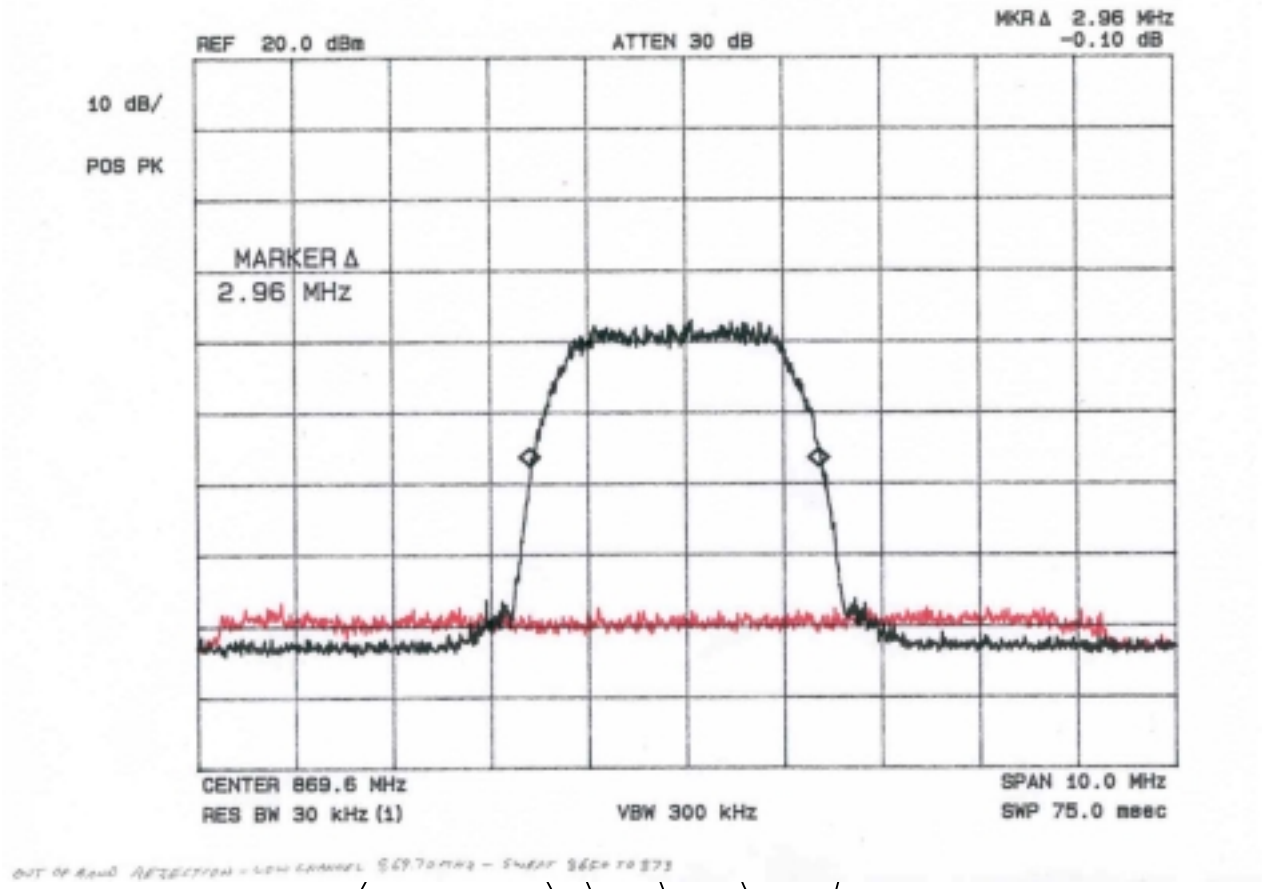
Frequency (MHz)	Harmonic	Measured Signal (dBμV) @ 30kHz RBW	Limit Lines (dBm)	Delta Limit Peak (dBc)
893.3678	1st	146.7	N/A	NA
1786.742	2nd	48.5	93	44.5
2680.114	3rd	25.4	93	67.6
3573.48	4th	39.4	93	53.6
4466.845	5th	60.1	93	32.9
5360.223	6th	43.8	93	49.2
6253.594	7th	73.9	93	19.1
7146.961	8th	53.6	93	39.4
8040.321	9th	33.5	93	59.5
8933.698	10th	84.3	93	8.7



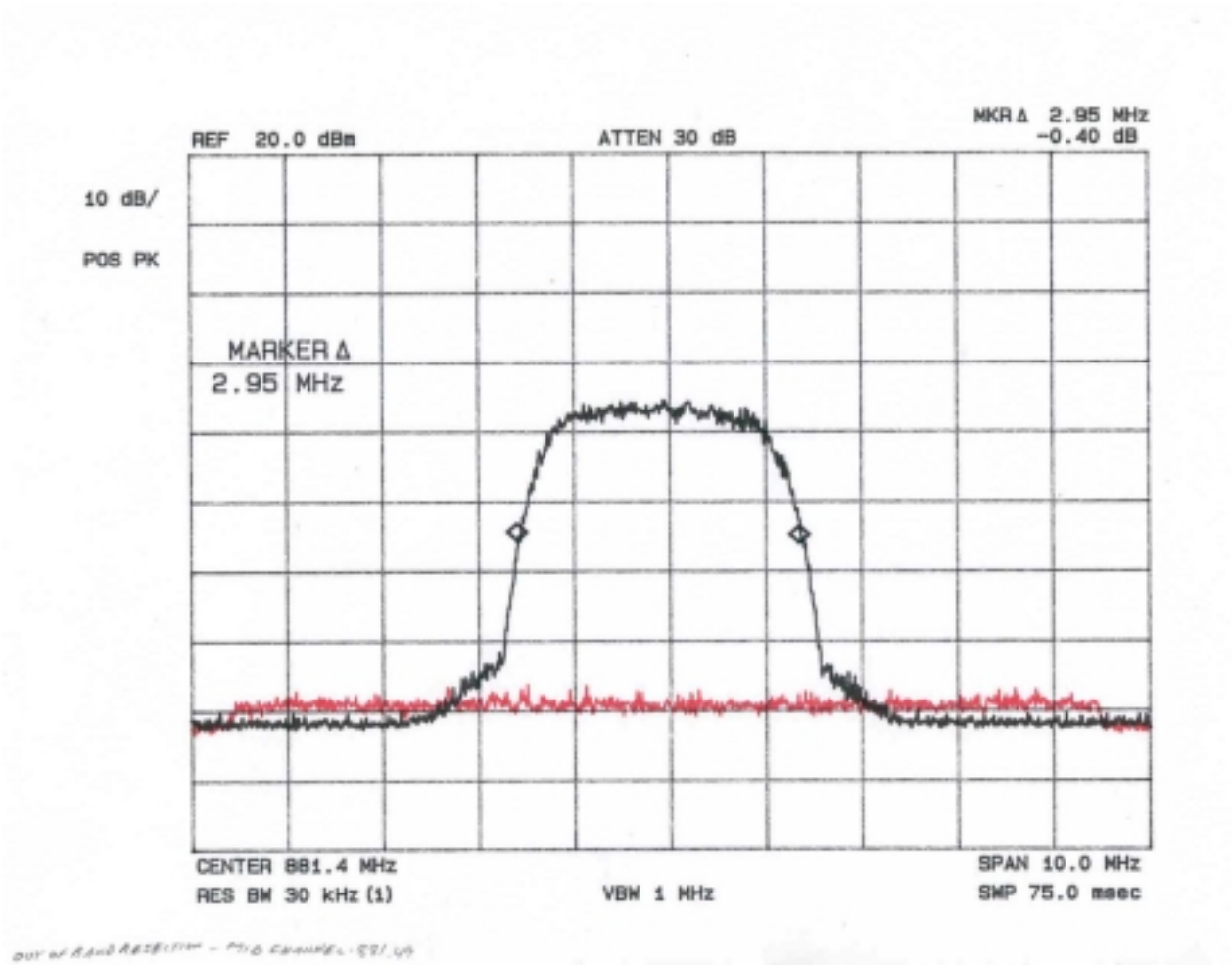
Bandedge at Terminal - Low end
869.70 MHz



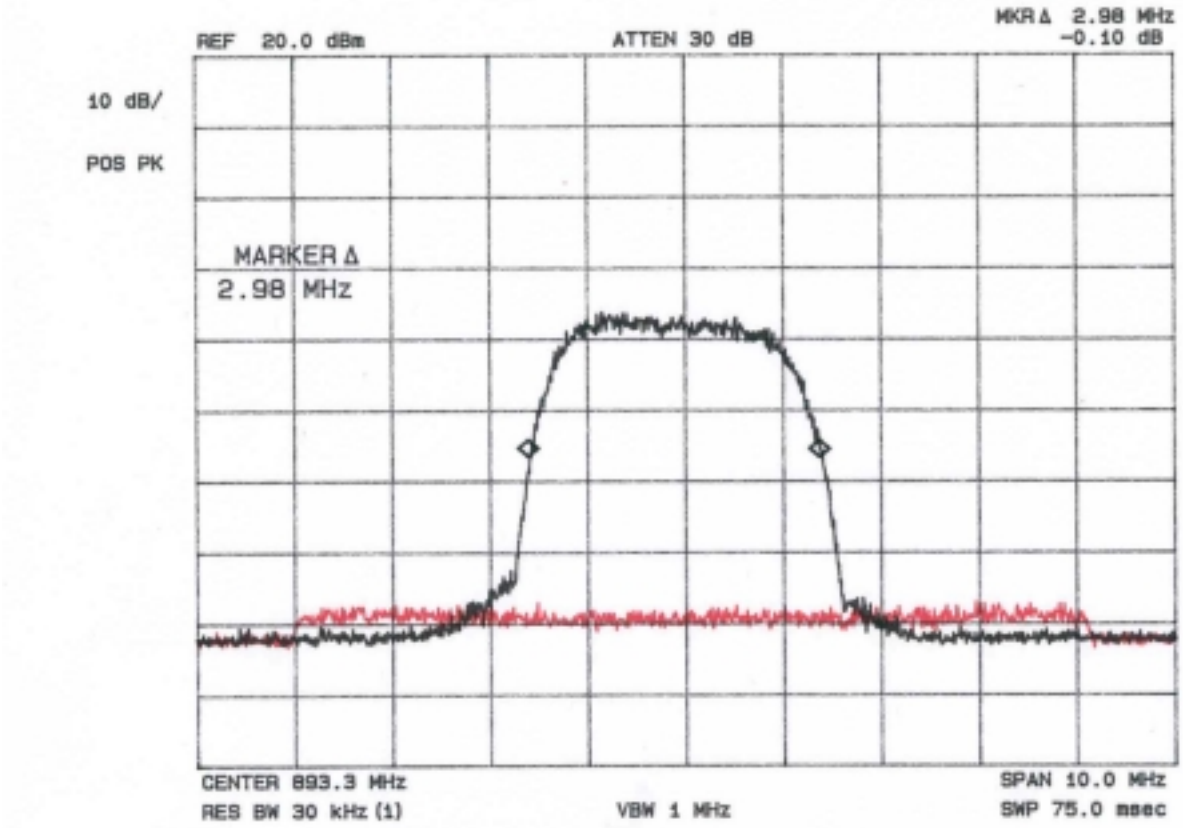
Bandedge at Terminal - High end
893.370 MHz



Out of Band Rejection at 869.70 MHz



Out of Band Rejection at
881.490 MHz



Out of Band Rejection at 893.370 MHz

Part 5 – Frequency Stability

DATE: April 25, 2005

TEST STANDARD: FCC CFR47, Part 2.1055; 24.235

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: As required by §2.1055 of CFR 47, stability measurements were made at the antenna output terminal using a 50 Ohm attenuator and spectrum analyzer set for a 10Hz resolution bandwidth.

The Temperature Stability part of the test was performed at the manufacturers location with the manufacturers test equipment. The measurements were taken over the temperature range of –30 to +50 deg. Celsius, in 10 deg. increments for each of the Frequencies under test. The measurements were taken after the frequency and unit had stabilized for each frequency and temperature.

The Voltage Stability part of the test were performed at our labs. The measurements were taken over the voltage range of 93.5Vac to 126.5Vac, which is the 85% to 115% of the rated operating Voltage of 110Vac. Using our in-house equipment.

CABLING DETAILS: The EUT was set up using the manufacturer's specified normal cabling configuration.

CABLING:

Cable	Connector	Load/Termination	Shielded	Ferrites
RG174	SMA Male	19.2 Mμ2 Ref	Yes	No
RG58	N Male	50 Ohm Load	Yes	No
RG174	SMA Male	Frequency Generator	Yes	No
RG6	N Male	Attenuators/Spectrum Analyzer	Yes	No
Power Cord	3 Prong AC Plug	120VAC	No	No
RS-232 Serial	DB-9 male	PC Serial Port	Yes	No

MODIFICATIONS: No modifications were required for the device to pass the test.

STANDARD: §2.1055 of CFR 47 does not specify a limit. Therefore the manufacturer has set a tolerance of +/- 2.5 PPM as an appropriate level to meet this requirement.

EMISSIONS DATA: See the following pages for the data.

PERFORMANCE: Complies with standard.

Frequency Stability over Temperature Range.

Temperature (°C)	Low Frequency Channel 1013 869.700 MHz	Middle Frequency Channel 383 881.490 MHz	High Frequency Channel 779 893.370 MHz
+50	869.700000	881.490000	893.370000
+40	869.700000	881.490000	893.370000
+30	869.700000	881.490000	893.370000
+20	See Voltage table below		
+10	869.700000	881.490000	893.370000
0	869.700000	881.490000	893.370000
-10	869.700000	881.490000	893.370000
-20	869.700000	881.490000	893.370000
-30	869.700000	881.490000	893.370000

Temperature tests performed by Manufacturer
Instrumentation Reference Frequency: 10.000000 MHz
RBW=1.8Hz; Span=200Hz

Frequency Stability over Voltage Range.

Voltage (Vac)	Low Frequency Channel 1013 869.700 MHz	Middle Frequency Channel 383 881.490 MHz	High Frequency Channel 779 893.370 MHz
126.5	869.6999904	881.4899979	893.3700015
115.5	869.6999945	881.4899996	893.3700029
110.0	869.7000002	881.4900004	893.3700005
104.5	869.6999997	881.4899935	893.3700013
93.5	869.6999987	881.4899921	893.3700008

Voltage tests performed by Protocol Data Systems.
Performed at: +20°C
Nominal Voltage: 110.0Vac 60Hz
RBW=10Hz; Span=100Hz

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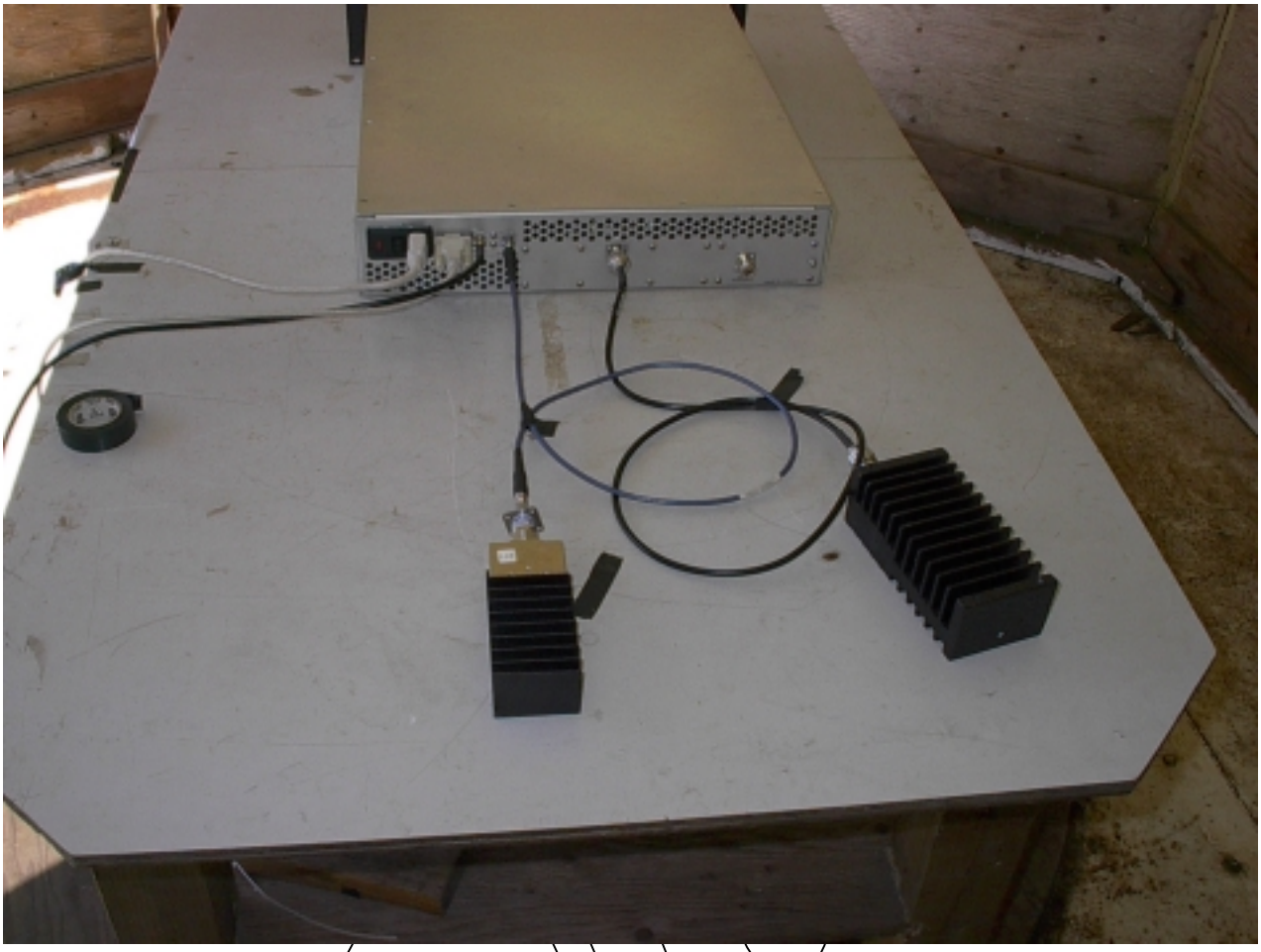
Appendix A: EUT Photos

Emissions Test Setup Front View



Emissions Test Setup Back View of Cables

Appendix B: Measurement Data and Plots

UTStarcom Canada – Raven iPA 800 Amplifier

Conducted Emissions

Table 1: Line 1 - 120Vac 60Hz

Frequency (MHz)	Peak (dBμV)	DelLim-Pk (dB)
15.160	44.3	-15.7
0.4233	49.0	-17.0
0.2072	43.3	-22.7
0.2105	42.9	-23.1

Table 2: Line 2 - 120Vac 60Hz

Frequency (MHz)	Peak (dBμV)	DelLim-Pk (dB)
13.63	48.5	-11.5
0.4255	49.2	-16.8
15.160	39.6	-20.4
0.2105	44.1	-21.9

Radiated Emission Class A – 3 m

Table 5: FCC Part 15 Emissions – in quiescent mode while connected to PC

Frequency	Ant. Pol	Ant. Hgt	Ang	Uncor-Pk	Tot Corr	Peak	QP Lmt (corrected to 10m)	DelLim-Pk (corrected to 10m)
(MHz)		(m)	(deg)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
62.30141	V	1	30.00	9.30	6.27	15.57	49.53	-33.96
240.53323	H	2.0	0	7.70	16.87	21.57	56.90	-35.33

No other frequencies detected

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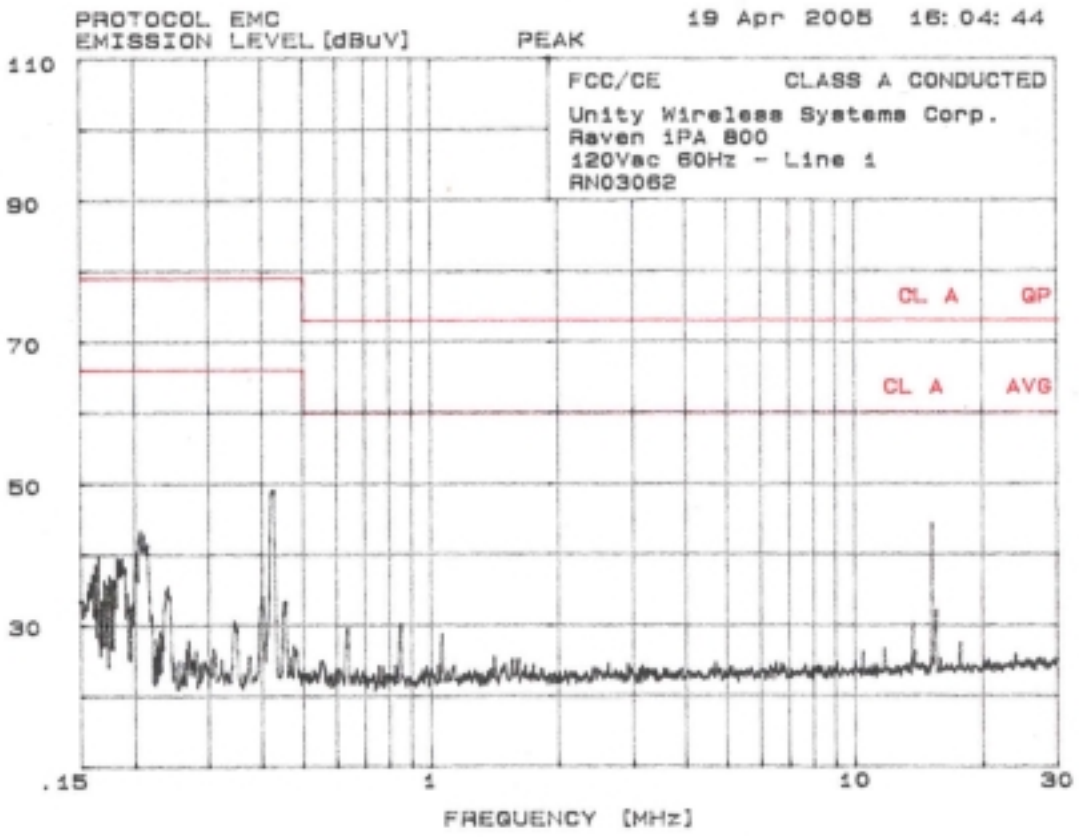
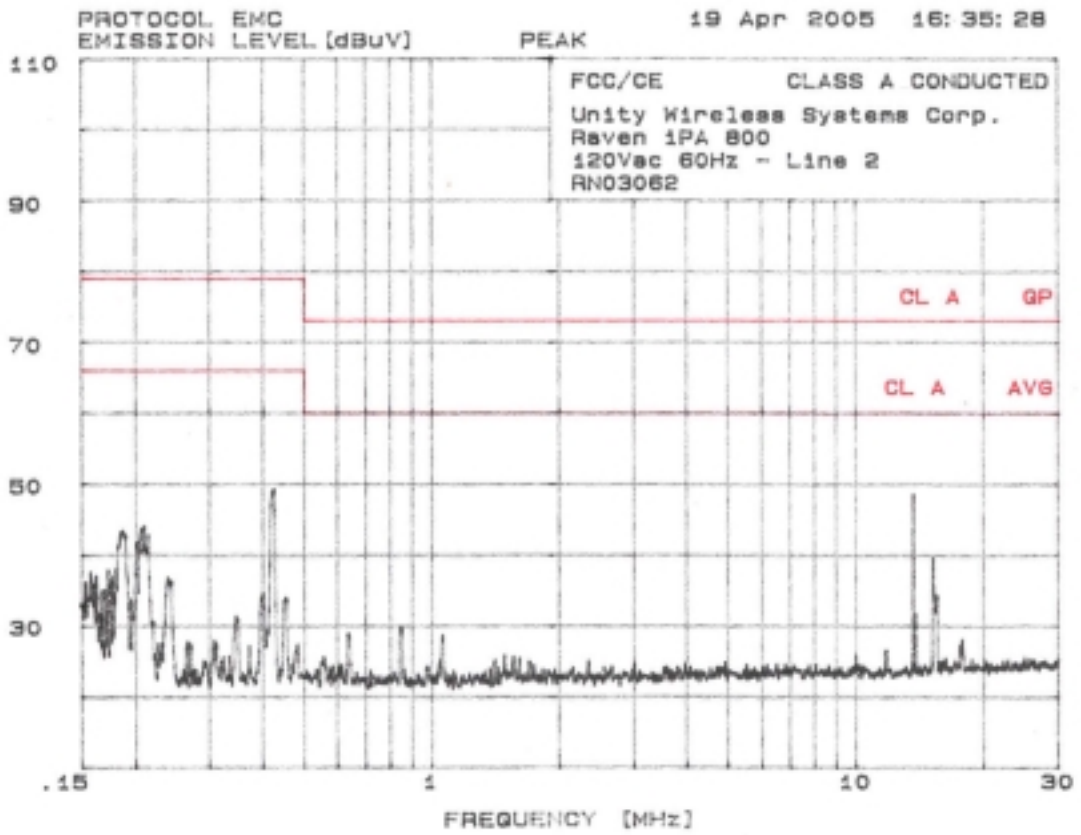
Conducted Emissions



Conducted Emissions Line 1 – 120Vac, 60Hz



Conducted Emissions Line 2 – 120Vac, 60Hz