Icron Technologies Corporation WiRanger System (LEX and REX)

Report of Measurements
per
FCC CFR47 Part 15/B Class B
FCC CFR47 Part 15/C 15.247

Revision 1.0

February 23, 2007

Approved by		
Checked by	David Johanson, EMC Engineer	23 Feb 07 Date

Protocol Datasystems Inc. EMC Lab, Abbotsford BC, Canada
FCC O.A.T.S Registration Number 96437
Industry Canada O.A.T.S Registration Number IC3384

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Section I: Report of Mesurements Testing Information

Testing Details

TESTED BY: Emissions: David Johanson

TEST CONDITIONS: Temperature and Humidity: 25°C, 68%

TEST VOLTAGE: 120Vac 60Hz

Test Facilities

Protocol Datasystems Inc., EMC Lab
28945 McTavish Rd.
Abbotsford BC, Canada, V4X 2E7

FCC O.A.T.S. Registration Number 96437
Industry Canada O.A.T.S. Registration Number IC3384

Test Equipment List

EMISSION:

Manufacturer	Model	Equipment Description	Serial No.	Last Cal	Next Cal
HP	85650A	CDN Quasi-Peak Adapter	2043A00240	12/07/06	12/07/07
HP	85662A	Spectrum Analyzer Display	2318A05184	12/07/06	12/07/07
HP	8566B	Spectrum Analyzer RF Section	2241A02102	12/07/06	12/07/07
HP	85685A	RF-Preselector	3107A01222	12/07/06	12/07/07
EMCO	EM6912	Antenna Biconical 20-300MHz	380	06/03/06	06/03/07
EMCO	3146	Ant. Log Periodic 200-1000MHz	9402-3776	17/02/06	17/02/07
EMCO	3115	Antenna Horn 1-18GHz	9005-3429	07/03/06	07/03/07
SOLAR	8012-50-R-24-BNC	LISN(25A 50ohm 50/250uH 10k-50MHz)	863092	28/09/06	28/09/07
Rhientech	Custom	Antenna Mast	N/A	N/A	N/A
Protocol EMC	Custom	Turntable	N/A	N/A	N/A

Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	±1 x 10-5
Total RF power, conducted	±1,5 dB
RF power density, conducted	±3 dB
Spurious emissions, conducted	±3 dB
All emissions, radiated	±6 dB
Temperature	±1°C
Humidity	±5 %
DC and low frequency voltages	±3 %

Company Under Test

NAME: Icron Technologies Corporation

ADDRESS: Suite 221 – 4664 Lougheed Highway
Burnaby, BC V5C 5T5

CONTACT PERSON: Mr. Faik Eljezovic

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PHONE NUMBER: 604-638-3921

FAX NUMBER: 604-638-3930

Equipment Under Test

THE TEST SYSTEM:

EUT 1: WiRanger REX
Manufacturer: Icron Technologies Corporation
Part Number: 10-00108
Serial Number: ENG-001

EUT 2: WiRanger LEX
Manufacturer: Icron Technologies Corporation
Part Number: 10-00107
Serial Number: ENG001

EUT 3 & 4: 90~264Vac to 5Vdc Switching Power Supply
Manufacturer: Sunny Computer Technology Company Ltd.
Part Number: SYS1308-1505-W2

Antenna1: Antenna 2.4GHz Full Wave
Manufacturer: Wellshow Technology Co., Ltd.
Part Number: WSTS-AW24RSMA-001

AUX EQUIP 1: Laptop
Manufacturer: IBM Thinkpad R51
Part Number: 1836QNU
Serial Number: 99-KM192

AUX EQUIP 2: Programming module
Manufacturer: Icron Technologies Corporation
Part Number: 40-00051
Serial Number:

AUX EQUIP 3 Generic PC
Manufacturer: (motherboard) Intel
Part Number: D865GLC MATX P4

AUX EQUIP 4 Memory Stick – Ultra Mini Micro Vault 256MB
Manufacturer: Sony
Part Number: USM256DS
Serial Number: BA04041900301

Test Software PC test software
Manufacturer: Atheros
Part Number: Radio Test
Version Number: 5.3

EUT Firmware WiRanger Firmware
Manufacturer: Icron
Part Number: 94-00075-A01

Programmer Firmware WiRanger system radio firmware
Manufacturer: Atheros
Part Number: Access Point
Version Number: 4.1.4.18

Cabling

Ref	Cable	Pins	Connector	Termination	Shielded	Ferrites
1	Power Supply	2	1.6mm Coaxial	No	No	No
2	USB Male to Female 1m	4	USB Type A to Type B	No	Yes	No

TEST SETUP: Each of the units, LEX and REX, was tested independently for Unintentional and Conducted Intentional radiated emissions. The REX module is a 4-port USB hub. The LEX module is the USB interface to the host computer that uses a standard USB cable. The method of wireless communications is a Digital Modulation Spread Spectrum signal operating in accordance with IEEE 802.11g 2.4GHz band.

For Unintentional emissions tests, the REX was tested in its normal mode of operation, when not in communications with a LEX module. In this mode of operation, the REX transmitter is making periodic broadcasts, looking for a LEX module to communicate with. A Memory Stick was connected to one of the USB ports. The LEX module was programmable to easily turn off the Transmitter so it was tested with the Transmitter Off.

For Intentional Conducted emissions testing of the Transmitters for both the REX and the LEX, the tests were performed while the Spectrum Analyzer was connected directly to the Antenna port. For these tests, each unit was connected to a Programming Module that put the transmitter into its various modes of operation. Since the transmitter portion of the circuitry is the same for both units, the reported results are for the REX unit only. The output power and the Conducted spurious emissions are the same for both units.

For the Spurious Radiated emissions were performed while the 2 units were broadcasting to each other using their antennas. Due to the programming that was in each unit, it is not possible to run this test with just using a 50Ω load.

Refer to Appendix A for photos about Cables and setup. Refer to Appendix B for the Part15/B and ICES-003 Radiated and Conducted Emission data.

MODIFICATIONS: These units require no modifications for them to pass.

CONCLUSION: The Icron Technologies WiRanger REX and LEX complies with the requirements of FCC CFR47 Part 15/B Class B; Part 15.247. These test results are representive of the provided samples given to us for testing as documented above in the EUT section

Section II: Report of Measurements to FCC 47CFR Ch. I

General

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15 – Subpart B – Unintentional Radiators Class B and Subpart C - Part 15.247 Intentional Radiators Operating within the band 2400-2483.5 MHz.

The specific sections used for Part 15.247 compliance is contained in the sections relating to Digital Modulation Systems and references to Digital Sequence Spread Spectrum (DSSS). Testing was performed in accordance with the Guidelines from the FCC Knowledge Database 558074 Measurement of Digital Transmission Systems Operating under Section 15.247.

Requirements for Intentional Radiators

According to 47CFR Ch. I FCC 15.201 Equipment authorization requirement paragraph
(b) *"Except as otherwise exempted in paragraph (c) of this section and in § 15.23 of this part, all intentional radiators operating under the provisions of this part shall be certificated by the Commission pursuant to the procedures in subpart J of part 2 of this chapter prior to marketing."*

Labelling and Markings

You should refer to the clauses of FCC part 2 Section 2.925 and FCC part 15 Section 15.19 for information to be contained on the label as well as information about the label. Any other statements or labelling requirements may appear on a separate label at the option of the applicant/grantee.

According to FCC Part 2 Section 2.925(a)." Each equipment covered in an application for equipment authorization shall bear a nameplate or label listing the following:

> (1) FCC Identifier consisting of the two elements in the exact order specified in § 2.926. The FCC Identifier shall be preceded by the term FCC ID in capital letters on a single line, and shall be of a type size large enough to be legible without the aid of magnification. Example: FCC ID XXX123. XXX—Grantee Code and 123—Equipment Product Code "

According to FCC Section 15.19(a)(3), the following statement must be included on the identification label:

> "This equipment complies with FCC Rules, Part 15 Digital Device. Operation is subject to the following two conditions: 1) This device may not cause harmful interference, and 2) This device must accept any interference that may cause any undesired operation"

According to FCC Section 15.19(b) the FCC logo is not required for this product since it does not fall under the rules for a Product subject to authorization under a Declaration of Conformity.

User Manual Statements

According to FCC Section 15.105 (b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

> NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

— Reorient or relocate the receiving antenna.
— Increase the separation between the equipment and receiver.
— Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/ TV technician for help.

According to FCC Section 15.21, a caution statement is to be included. It can be similar to:

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

According to FCC Section 2.1091, a caution statement about the RADIOFREQUENCY RADIATION EXPOSURE limitation of a separation of at least 20 centimeters is required.

> **§ 2.1091** (b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. In this context, the term ''fixed location'' means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20-centimeter separation requirement.

FCC Test Results Summary

Test	Standard	Description	Result
Unintentional Radiated Emissions - Idle Mode	FCC PART 15 Subpart B 15.109 Class B Limits; Subpart C 15.209	The radiated emissions are measured in the 30-1000Mhz range	Complies
Unintentional AC Mains Conducted Emissions - Idle Mode	FCC PART 15 Subpart B 15.107 Class B Limits; Subpart C 15.207	The Conducted Emissions are measured on the phase and Neutral Power lines in the 0.15 - 30.0 MHz range.	Complies
Intentional Radiated Emissions - Transmit Mode	FCC Part 15.247(a)(2)	Bandwidth	Complies
Intentional Radiated Emissions - Transmit Mode	FCC Part 15.247(b)(3)	RF Power Output	Complies
Intentional Radiated Emissions - Transmit Mode	FCC Part 15.247(b)(5)	RF Safety	Complies
Intentional Radiated Emissions - Transmit Mode	FCC Part 15.247(c)	Conducted Spurious Emissions	Complies
Intentional Radiated Emissions - Transmit Mode	FCC Part 15.247(c)	Radiated Spurious Emissions	Complies
Intentional Radiated Emissions - Transmit Mode	FCC Part 15.247(d)	Power Spectral Density	Complies

Part 1 - Unintentional Radiated Emission Testing

DATE: January 31, 2007

TEST STANDARD: FCC 47CFR, Part 15, Subpart B 15.109 – Class B
FCC 47CFR, Part 15, Subpart C 15.209 – Class B

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: The REX was tested in its normal mode of operation, when not in communications with a LEX module. In this mode of operation, the REX transmitter is making periodic broadcasts, looking for a LEX module to communicate with. A Memory Stick was connected to one of the USB ports. The LEX module was tested in the same manner and was connected to a Laptop USB port. The LEX was tested with the Transmitter Off.

MINIMUM STANDARD: Class B Limits:

Frequency	**Field Strength at 3m**	
MHz	µV/m at 3m	dBµV/m at 3m
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
960 - above	500	54.0

METHOD OF MEASUREMENT: The equipment was set up in a 3-meter open field test site. Tests were performed using the manufacturer's specified normal cabling configuration, with all cables over 1 meter in length bundled at 1 meter and retained from the floor. A typical application was tested.

Emissions in both horizontal and vertical polarization's were measured while rotating the EUT on a turntable to maximize the emissions signal strength.

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

CABLE DESCRIPTIONS: cables as specified in **Section 1 - Cabling**

MEASUREMENT DATA: See Appendix B for corresponding frequencies tables and plots

PERFORMANCE: Complies.

Part 2 - AC Mains Conducted Emission Testing

DATE: January 29, 2007

TEST STANDARD: FCC 47CFR, Part 15, Subpart B 15.107– Class B
FCC 47CFR, Part 15, Subpart C 15.207

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: The EUT was connected to the conducted emissions LISN apparatus. The equipment was operated and tested at 120Vac 60Hz. The REX was tested in its normal mode of operation, when not in communications with a LEX module. In this mode of operation, the REX transmitter is making periodic broadcasts, looking for a LEX module to communicate with. A Memory Stick was connected to one of the USB ports. The LEX module was set up in the same operating mode.

MINIMUM STANDARD: Class B Limit:

Frequency (MHz)	**Conducted Limit** (dBμV)	
	Quasi-Peak	Average
0.15 - 0.50	66-56	56-46
0.50 - 5	56	46
5 - 30	60	50

METHOD OF MEASUREMENT: Measurements were made using a spectrum analyzer with 10kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 10kHz bandwidth, CISPR Quasi-Peak detector as well as an average detector meter.

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

CABLE DESCRIPTIONS: cables as specified in **Section 1 - Cabling**

MEASUREMENT DATA: See Appendix B for corresponding frequencies tables and plots

PERFORMANCE: Complies.

Part 3 - Antenna Requirement - 15.203

APPLICABLE REGULATIONS 2.1:

15.203 - An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

RESULT 2.2: This unit meets this requirement. The antenna is a 2.4 GHz Full wave whip antenna that uses a “Reverse SMA” connector. It is normally sold with the unit and installed at the site by the end-user. Replacement Antenna’s can only be ordered from the factory. The only antenna that has been tested for this product is the “ANTB92-072”

Part 4 - Bandwidth

DATE: February 02, 2007

TEST STANDARD: FCC CFR47, Part 15, Subpart C 15.247(a)(2)
Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: Since the REX and the LEX use the same RF circuitry and the PCB is the same for both products, only the LEX was fully tested. A sample test of the REX was performed to verify that it was also in compliance. The Conducted measurement was taken from the antenna port using a 1meter cable connected directly to the Spectrum Analyzers RF input.

In order to perform the tests, a Programming Module was connected directly to the LEX PCB and the LEX was programmed for Continuous Transmission, the required Frequency Channel as well as the Data Rate.

The LEX was tested for using channels 1 (2412MHz), 6 (2437MHz) and 11(2462MHz). For each channel, the LEX was programmed to transmit at its lowest Data Rate of 18Mbits/sec and its highest Data Rate of 54Mbits/sec.

The WiRanger system are programmed to only use channels 1 to 11 and a Data Rate of 18 to 54Mbits/sec in its normal mode of operation.

MINIMUM STANDARD: using a RBW = 100kHz, the 6dB bandwidth must be greater than 500kHz.

METHOD OF MEASUREMENT: The equipment was set up in on the labs test bench with a horizontal Ground Plane. The Programming PC was connected to the Programming Module using an Ethernet connection. The Programming module was connected directly to the REX/LEX PCB using a nut and bolt assembly. The LEX/REX Antenna port was connected directly to the Spectrum Analyzer using a 1Meter low-loss RF cable. Due to the low power levels, no attenuator was used on the Spectrum Analyzer input.

DEVICE DESCRIPTIONS: As described in the Equipment Under Test Section, above in Part 1.

CABLE DESCRIPTIONS: cables as specified in **Section 1 - Cabling**

MEASUREMENT DATA: See attached Plots after the Peak Power section and the table:

Frequency	Data Rate	6dB Bandwidth
(MHz)	(MBit/sec)	(MHz)
2412	18	16.62
2412	54	16.58
2437	18	16.46
2437	54	16.54
2462	18	16.48
2462	54	16.12

PERFORMANCE: Complies.

Part 5 - Power Output

DATE: February 02, 2007

TEST STANDARD: FCC CFR47, Part 15, Subpart C 15.247(b)(3)
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: Since the REX and the LEX use the same RF circuitry and the PCB is the same for both products, only the LEX was fully tested. A sample test of the REX was performed to verify that it was also in compliance. The Conducted measurement was taken from the antenna port using a 1meter cable connected directly to the Spectrum Analyzers RF input.

In order to perform the tests, a Programming Module was connected directly to the LEX PCB and the LEX was programmed for Continuous Transmission, the required Frequency Channel as well as the Data Rate.

The LEX was tested for using channels 1 (2412MHz), 6 (2437MHz) and 11(2462MHz). For each channel, the LEX was programmed to transmit at its lowest Data Rate of 18Mbits/sec and its highest Data Rate of 54Mbits/sec.

The WiRanger system is programmed to only use channels 1 to 11 and a Data Rate of 18 to 54Mbits/sec in its normal mode of operation.

MINIMUM STANDARD: When using a Spectrum Analyzer the RBW > (6dB Bandwidth 17MHz), the maximum peak conducted power of 1Watt.

METHOD OF MEASUREMENT: The equipment was set up in on the labs test bench with a horizontal Ground Plane. The Programming PC was connected to the Programming Module using an Ethernet connection. The Programming module was connected directly to the REX/LEX PCB using a nut and bolt assembly. The LEX/REX Antenna port was connected directly to the Spectrum Analyzer using a 1Meter low-loss RF cable. Due to the low power levels, no attenuator was used on the Spectrum Analyzer input.

Peak Measurements were taken using the Spectrum Analyzer set to a RBW=3MHz. The Transmitter was measured at 3 frequencies, using the lowest and highest modulated rates of 18 and 54Mbits/sec.

Since the requirement is for a Modulated signal measurement at a RBW greater then the 6dB bandwidth, the selected RBW=17MHz. The measurement was taken with RBW=3MHz. This measurement is corrected for cable loss and from dBμV to dBm and then is corrected to RBW=17 and then converted to Watts.

DEVICE DESCRIPTIONS: As described in the Equipment Under Test Section, above in Part 1.

CABLE DESCRIPTIONS: cables as specified in **Section 1 - Cabling**

MEASUREMENT DATA: See Peak level, indicated by the Display Line, in the following Plots and Table.

Frequency	Modulation	Raw Measurement	Cable Loss Correction	Corrected RBW=3MHz	Correction from dBµV	Corrected RBW=17MHzNote 1	Peak Power Note 2
(MHz)		(dBµV)	(dB)	(dBµV)	(dBm)	(dBm)	(Watt)
2412	18Mbit/sec	114.4	0.6	115.0	8.0	15.5	0.035
2412	54Mbit/sec	108.5	0.6	109.1	2.1	9.6	0.009
2437	18Mbit/sec	114.5	0.6	115.1	8.1	15.6	0.036
2437	54Mbit/sec	110.0	0.6	110.6	3.6	11.1	0.013
2462	18Mbit/sec	114.4	0.6	115.0	8.0	15.5	0.036
2462	54Mbit/sec	110.1	0.6	110.7	3.7	11.2	0.013

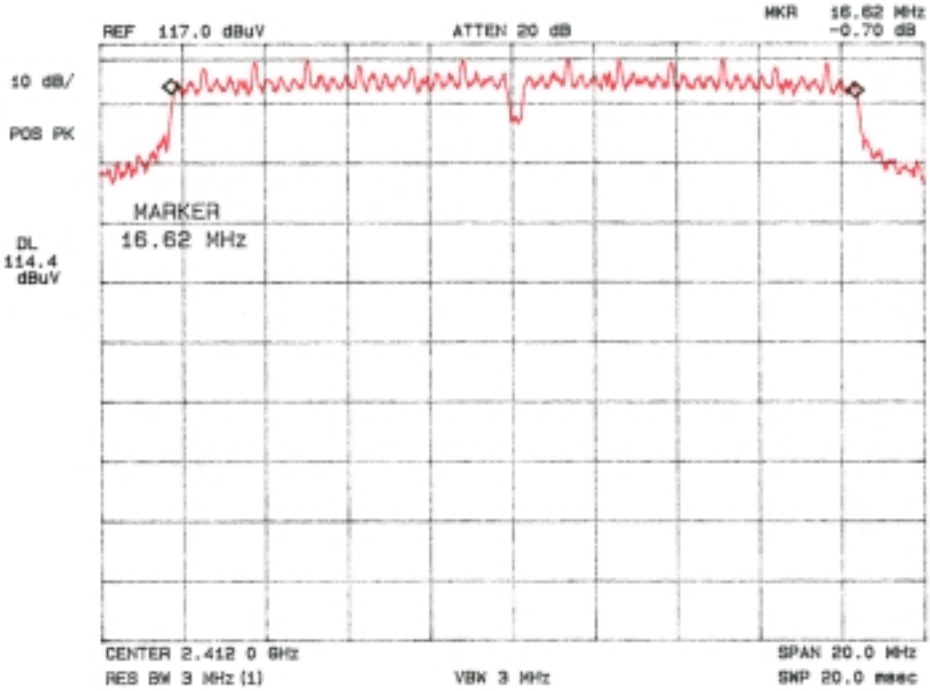
Note 1: The measured level, in dBm, is corrected by:

$$P_{(17MHz)} = (PdB\mu V_{(3MHz)} - 107) + 10Log(17MHz/3MHz) = P_{(3MHz)} + 7.53dB$$

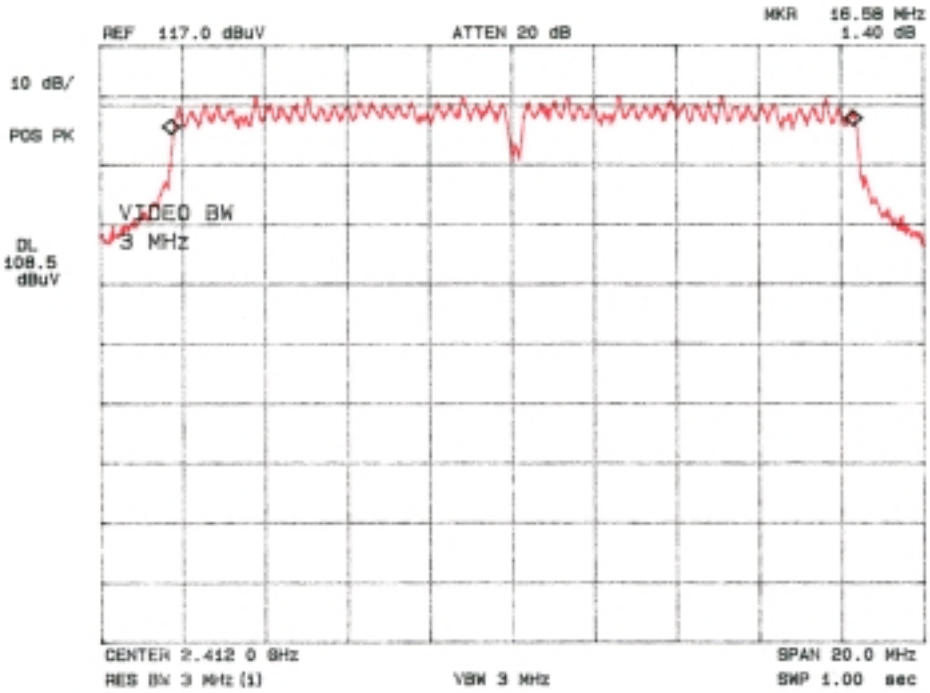
Note 2: The level in Watts is corrected by:

$$P_{(w)} = ((10^{(Pdbm)/10)})/1000)$$

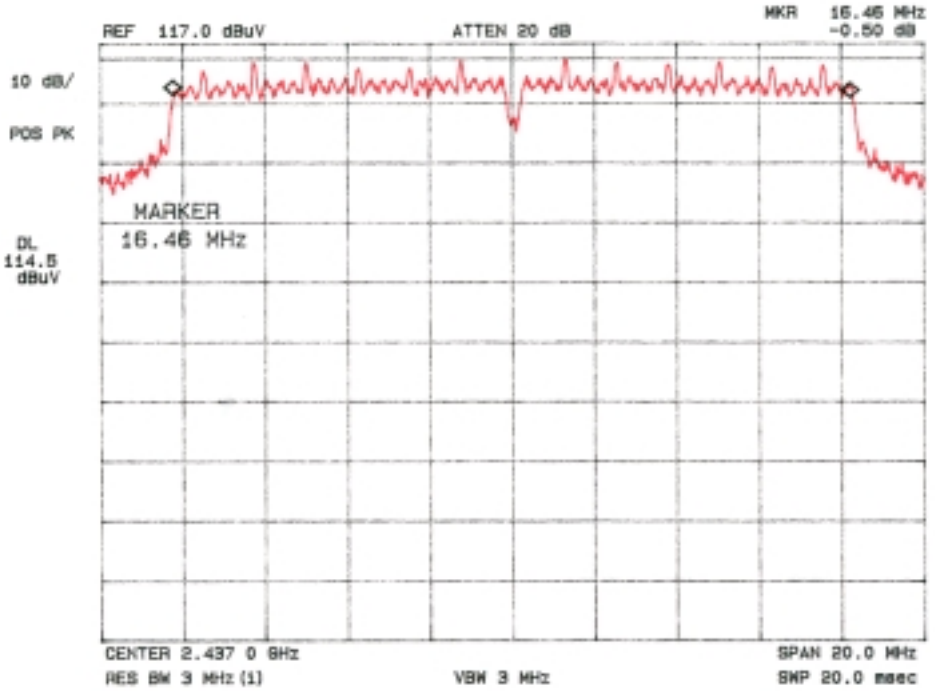
PERFORMANCE: Complies.



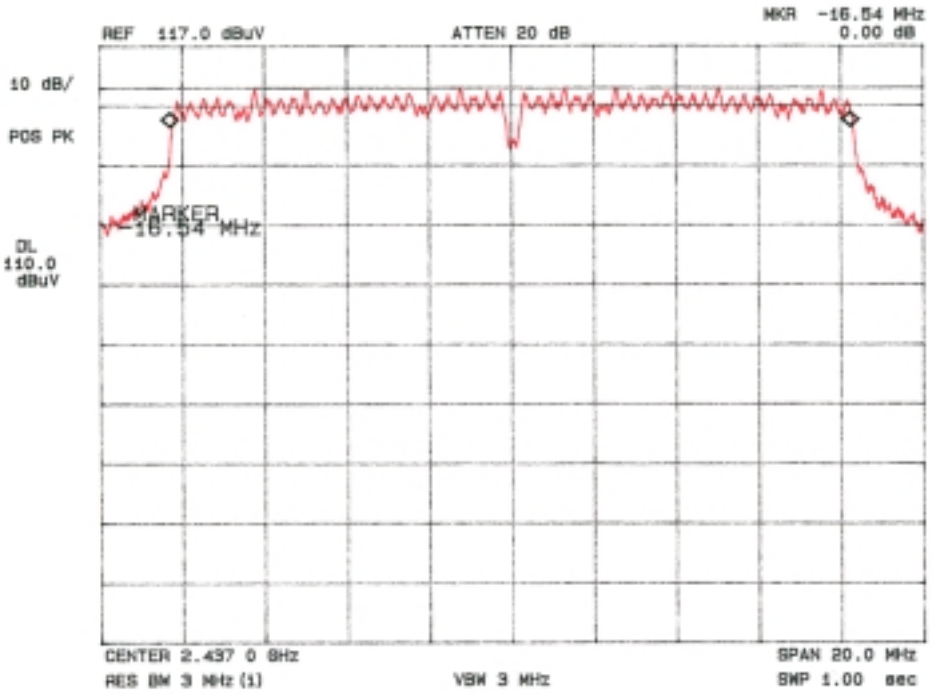
Peak Power and Bandwidth Plot 1: Channel 1 2412 MHz 18Mbit/sec



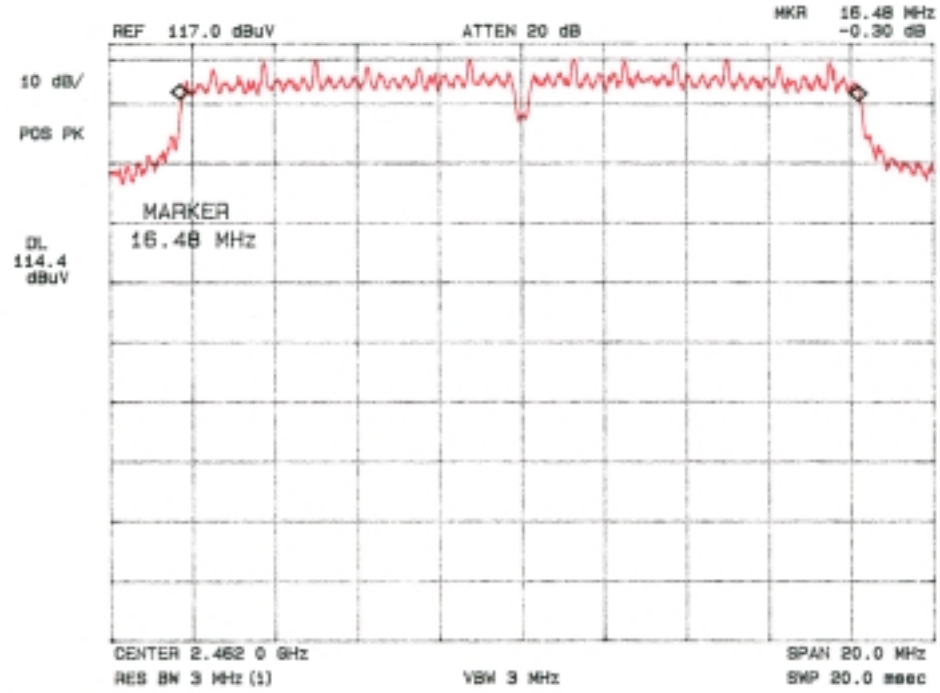
Peak Power and Bandwidth Plot 2: Channel 1 2412 MHz 54Mbit/sec



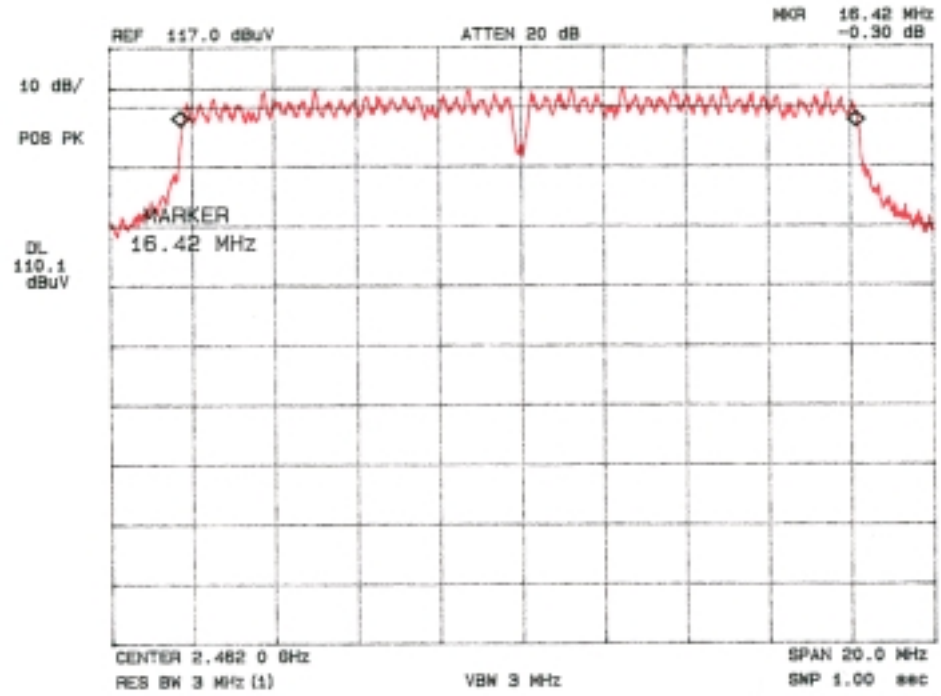
Peak Power and Bandwidth Plot 3: Channel 6 2437 MHz 18Mbit/sec



Peak Power and Bandwidth Plot 4: Channel 6 2437 MHz 54Mbit/sec



Peak Power and Bandwidth Plot 5: Channel 11 2462 MHz 18Mbit/sec



Peak Power and Bandwidth Plot 6: Channel 11 2462 MHz 54Mbit/sec

Part 6 - RF Safety

DATE:	February 02, 2007
TEST STANDARD:	FCC CFR47, Part 15, Subpart C 15.247(b)(5) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.
METHOD OF ASSESSMENT:	The Peak RF power is less then 1Watt and is using a 2dBi antenna. The product is used in an unlicensed band and meets the requirements of § 2.1091. The user is required to keep the transmitter a minimum of 20 centimeters away from themselves. The User Manual contains the warning as required by § 2.1091.
PERFORMANCE:	Complies.

Part 7 - Conducted Spurious Emissions

DATE: February 02, 2007

TEST STANDARD: FCC CFR47, Part 15, Subpart C 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, 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)).

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: Since the REX and the LEX use the same RF circuitry and the PCB is the same for both products, only the LEX was fully tested. A sample test of the REX was performed to verify that it was also in compliance. The Conducted measurement was taken from the antenna port using a 1meter cable connected directly to the Spectrum Analyzers RF input. In order to perform the tests, a Programming Module was connected directly to the LEX PCB and the LEX was programmed for Continuous Transmission, the required Frequency Channel as well as the Data Rate.

The LEX was tested for using channels 1 (2412MHz), 6 (2437MHz) and 11(2462MHz). For each channel, the LEX was programmed to transmit at its lowest Data Rate of 18Mbits/sec and its highest Data Rate of 54Mbits/sec.

The WiRanger system is programmed to only use channels 1 to 11 and a Data Rate of 18 to 54Mbits/sec in its normal mode of operation.

MINIMUM STANDARD: Using a RBW = 100kHz, Conducted Spurious emissions from the RF antenna port must be 20dB below the peak level measured within the band using a RBW=100kHz.

METHOD OF MEASUREMENT: The equipment was set up in on the labs test bench with a horizontal Ground Plane. The Programming PC was connected to the Programming Module using an Ethernet connection. The Programming Module was connected directly to the REX/LEX PCB using a nut and bolt assembly.
The LEX/REX Antenna port was connected to the Spectrum Analyzer using a 1-meter low-loss RF cable attached to a 30dB Attenuator and a second 1-meter low-loss RF cable. This attenuator was added to reduce the “Ghost” reflections within the Spectrum Analyzer. In order to ensure that the Attenuator would not cause too much attenuation of the signal, a sweep was first made without the Attenuator, and then it was added to verify if the signal was a real signal or a Ghost signal.
The LEX was investigated from 30MHz to 24GHz for each Frequency. Only the 18Mbit/sec modulation rate was investigated due to its higher power level. The band Edges were investigated for both 18 and 54Mbit/sec Modulation rates.

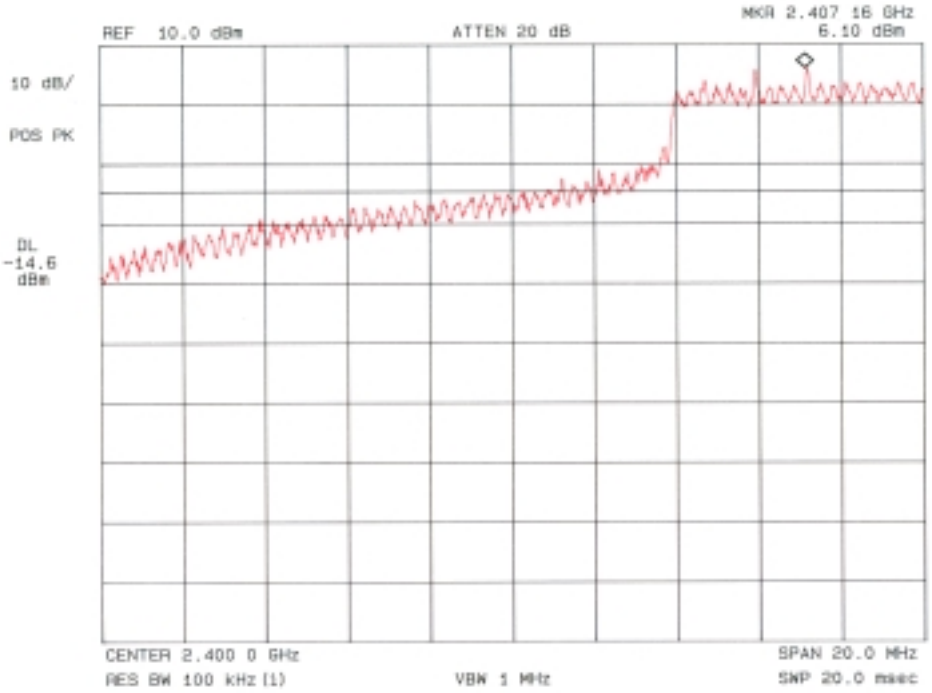
DEVICE DESCRIPTIONS: As described in the Equipment Under Test Section, above in Part 1.

CABLE DESCRIPTIONS: cables as specified in **Section 1 – Cabling**

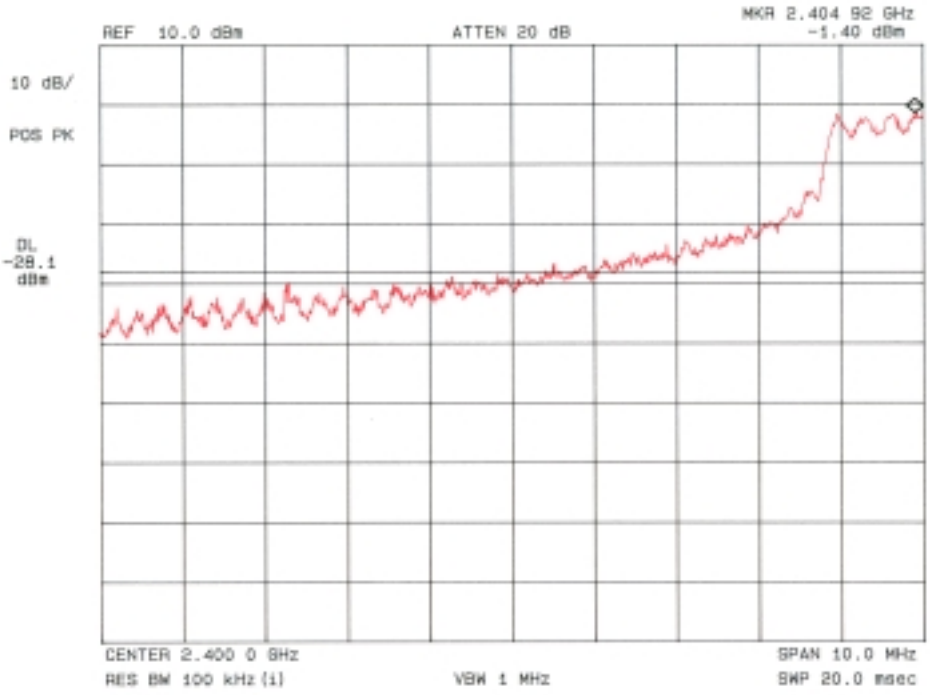
MEASUREMENT DATA: See attached Plots for Band Edge plots:

All spurious emissions within 30MHz to 24GHz were more then 40dB below the Peak Power level. No Harmonic emissions were detected for any of the investigated Channels.

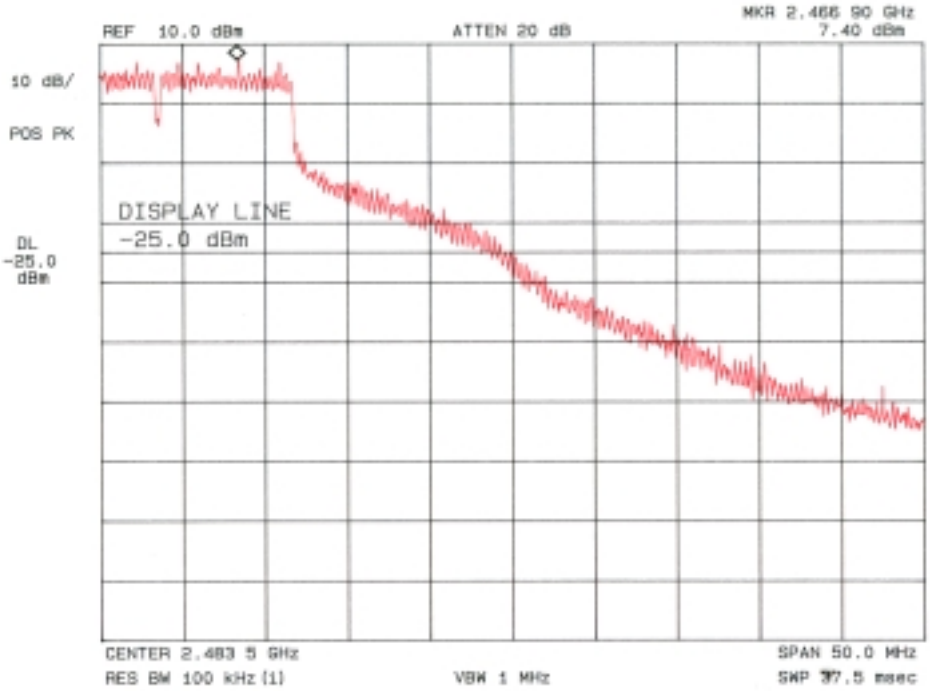
PERFORMANCE: Complies.



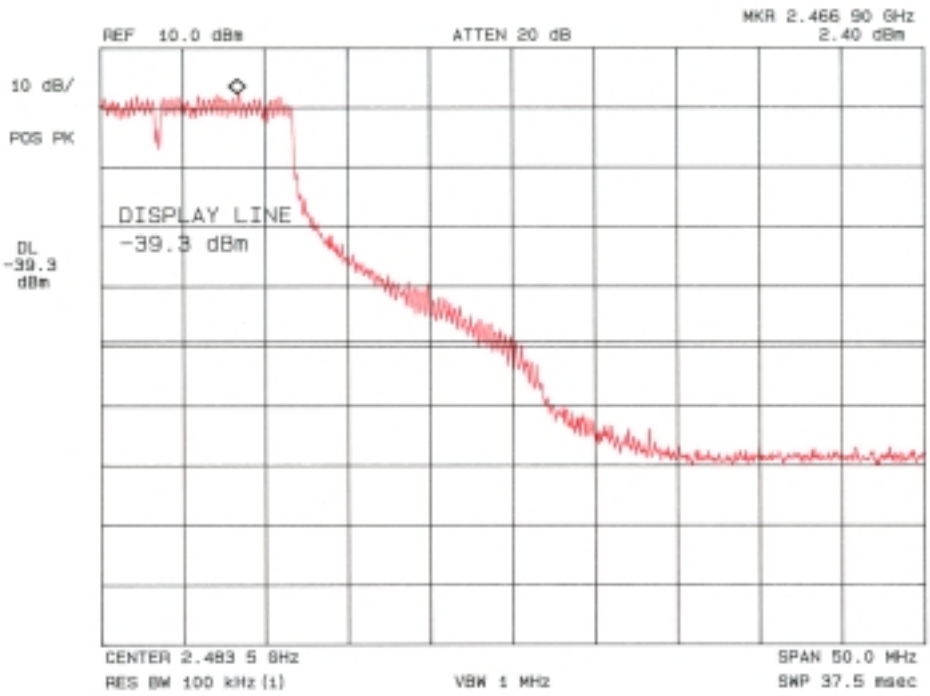
2400 Bandedge using 18Mbit/sec



2400 Bandedge using 54Mbit/sec



2483.5 Bandedge using 18Mbit/sec



2483.5 Bandedge using 54Mbit/sec

Part 8 - Radiated Spurious Emissions

DATE: February 07, 2007

TEST STANDARD: FCC CFR47, Part 15, Subpart C 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, 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)).

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP:

Freq. Range Measured	30 MHz – 24000 MHz
Test Distance	1 to 3m
Test Instrumentation resolution	100 KHz (30 MHz to 1000 MHz) 1MHz (1000 MHz to 25000 MHz)
Receive Ant. Scan Height	1m – 4m
Receive Ant. Polarization	Vertical and Horizontal.

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.
Both the LEX and the REX were on the table with a spacing of about 0.5 meters. The emissions were tested using radiated test procedures.

Due to the mode of programming for the LEX and REX, the emissions were measured while the LEX and the REX were in communications with each other while transferring data in both directions. In this mode of operation, only 1 Channel could be tested. The units were tested using channel 6 only. The data rate was not selectable and would only use the automatic rate for the distance. It was expected that due to the close proximity to each other, the data rate was probably at 54Mbit/sec.

MINIMUM STANDARD: Using a RBW = 100kHz, Radiated Spurious emissions from the RF antenna port must be below the levels defined in 15.209, in the Restricted bands as defined in section 15.205.

METHOD OF MEASUREMENT: The equipment was set up in a 3-meter open field test site. Tests were performed at both 3 meters and 1 meter using the manufacturer's specified normal cabling configuration, with all cables over 1 meter in length bundled at 1 meter and retained from the floor. A typical application was tested.

Emissions in both horizontal and vertical polarization's were measured while rotating the EUT on a turntable to maximize the emissions signal strength.

For frequencies above 2GHz, the HP Microwave Amplifier was used to increase the systems sensitivity. Since all measured peaks were less then the limit line, a filter was not used.

DEVICE DESCRIPTIONS: As described in the Equipment Under Test Section, above in Part 1.

CABLE DESCRIPTIONS: cables as specified in **Section 1 - Cabling**

MEASUREMENT DATA:

Most detected emissions were outside of the Restricted Bands. No frequencies were detected 7 to 24GHz. The following are the frequencies that were inside one of the Restricted Bands.

Frequency	Uncorrected Average Level	Corrections	Correction For 3m distance	Avg. Level	15.209 Limit Line	Delta from Limit
(MHz)	(dBµV)	(dB)	(dB)	(dBµV)	(dBµV)	(dB)
249.000	17.7	12.71	0	31.4	46.0	-14.6
325.000	11.6	16.4	0	28.0	46.0	-18.0
4861.00	15.90	25.8	-9.5	16.3	53.0	-37.7

PERFORMANCE: Complies.

Part 9 - Power Spectral Density

DATE: February 02, 2007

TEST STANDARD: FCC CFR47, Part 15, Subpart C 15.247(e)
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

TEST VOLTAGE: 120Vac, 60Hz

TEST SETUP: Since the REX and the LEX use the same RF circuitry and the PCB is the same for both products, only the LEX was fully tested. A sample test of the REX was performed to verify that it was also in compliance. The Conducted measurement was taken from the antenna port using a 1meter cable connected directly to the Spectrum Analyzers RF input.

In order to perform the tests, a Programming Module was connected directly to the LEX PCB and the LEX was programmed for Continuous Transmission, the required Frequency Channel as well as the Data Rate.

The LEX was tested for using channels 1 (2412MHz), 6 (2437MHz) and 11(2462MHz). For each channel, the LEX was programmed to transmit at its lowest Data Rate of 18Mbits/sec and its highest Data Rate of 54Mbits/sec.

The WiRanger system is programmed to only use channels 1 to 11 and a Data Rate of 18 to 54Mbits/sec in its normal mode of operation.

MINIMUM STANDARD: using a RBW = 3kHz, the Peak Power Density must be below 8dBm.

METHOD OF MEASUREMENT: The equipment was set up in on the labs test bench with a horizontal Ground Plane. The Programming PC was connected to the Programming Module using an Ethernet connection. The Programming module was connected directly to the REX/LEX PCB using a nut and bolt assembly. The LEX/REX Antenna port was connected directly to the Spectrum Analyzer using a 1Meter low-loss RF cable. Due to the low power levels, no attenuator was used on the Spectrum Analyzer input.

DEVICE DESCRIPTIONS: As described in the Equipment Under Test Section, above in Part 1.

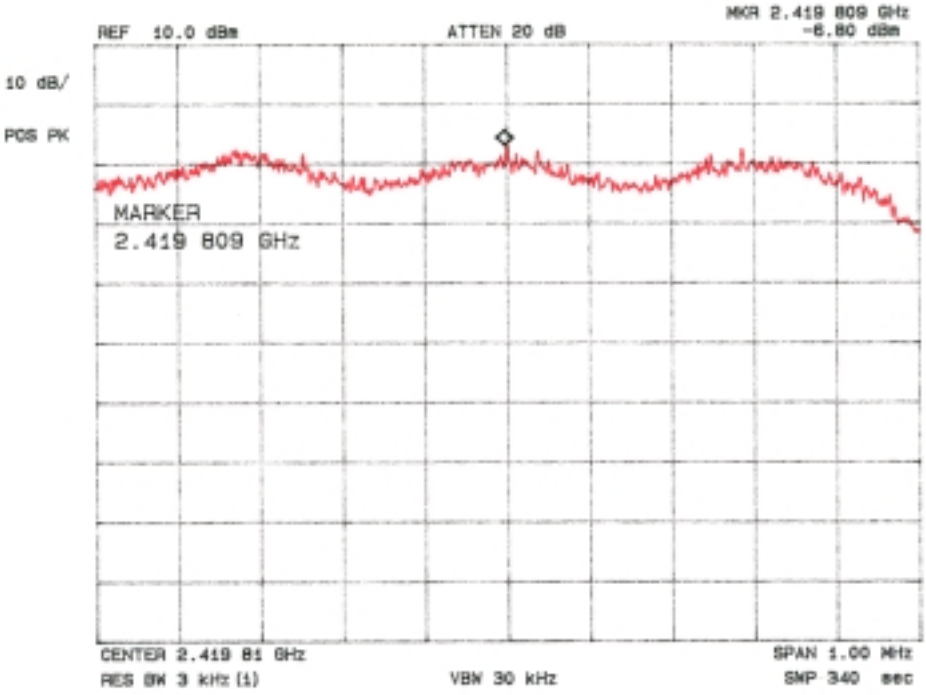
CABLE DESCRIPTIONS: cables as specified in **Section 1 - Cabling**

MEASUREMENT DATA: See attached Plots after the Peak Power section and the table:

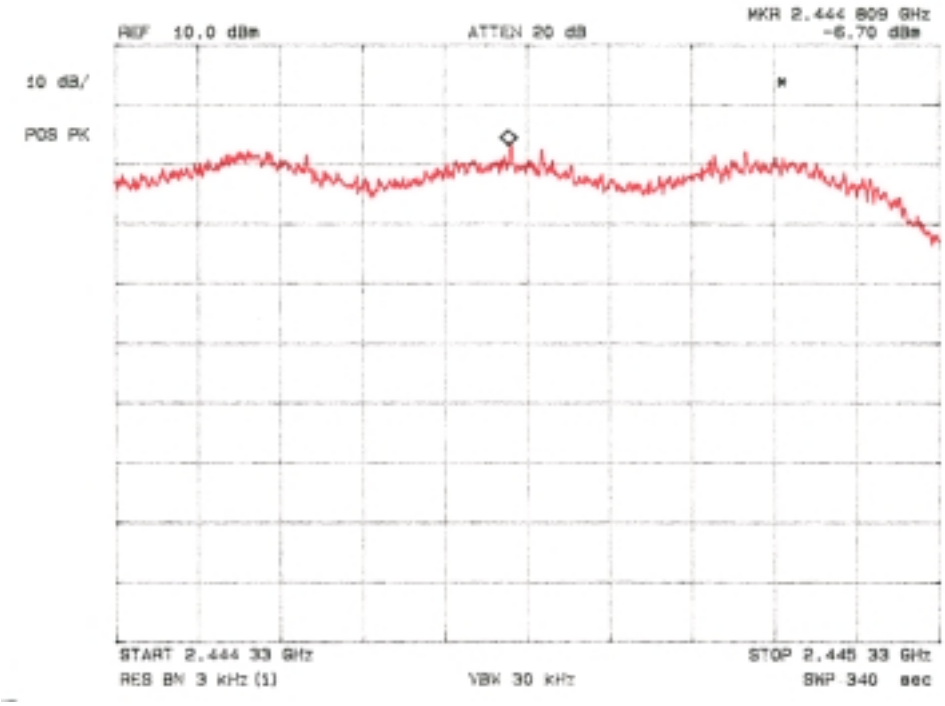
Since the 18 Mbit/sec modulation rate produces a higher Power level, the 54Mbit/sec modulation option was not measured.

Frequency	Data Rate	Power Spectral Density (with corrections)
(MHz)	(MBit/sec)	(dBm)
2412	18	-6.2
2437	18	-6.1
2462	18	-5.7

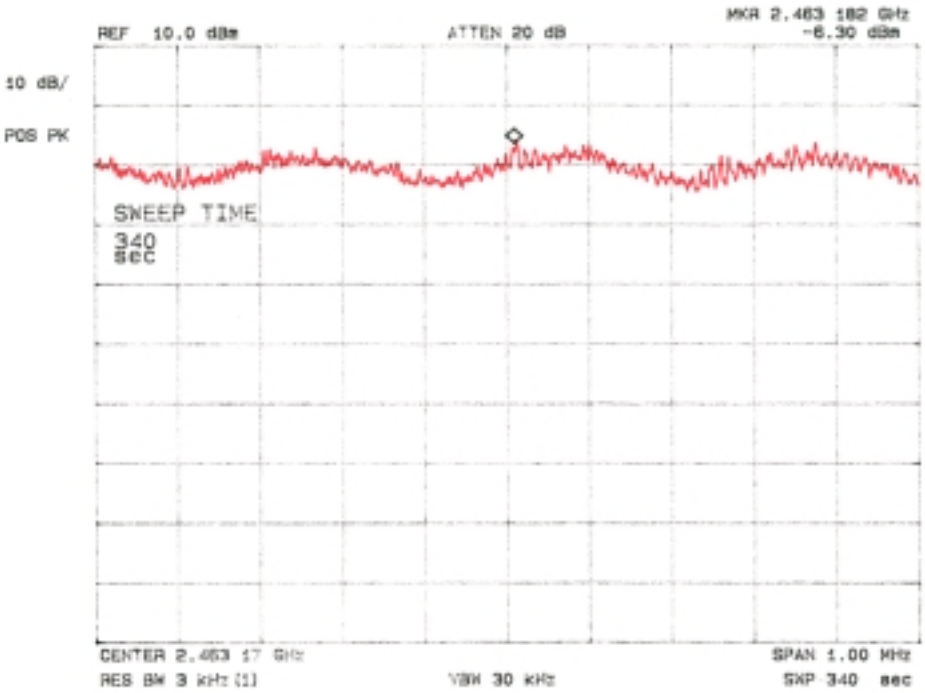
PERFORMANCE: Complies.



Power Spectral Density – 2412 MHz 18Mbit/sec



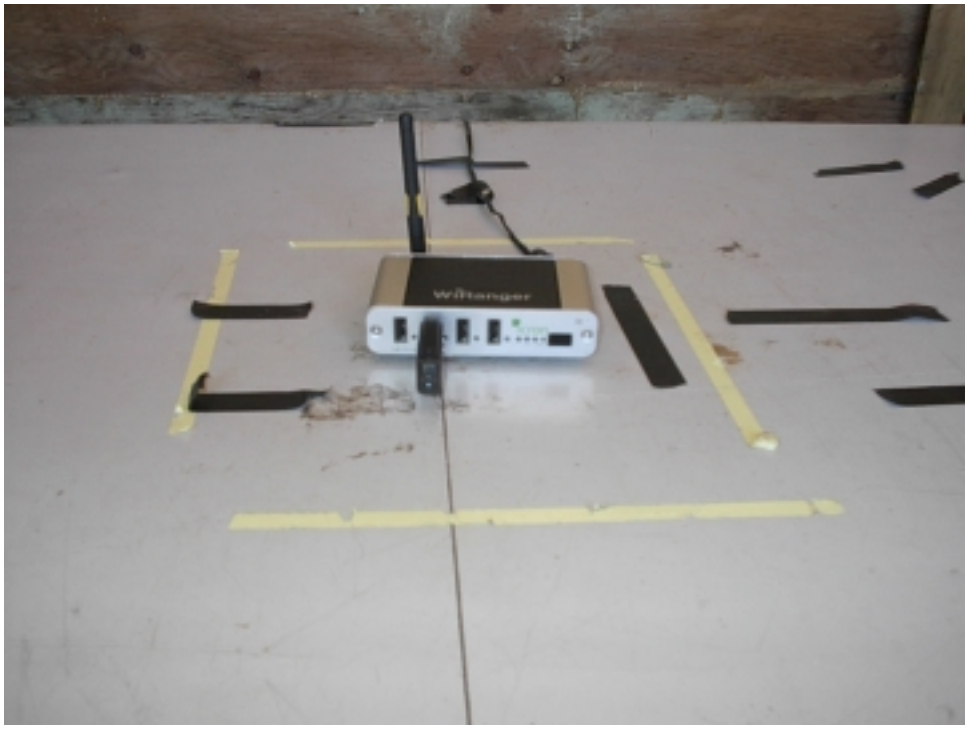
Power Spectral Density – 2437 MHz 18Mbit/sec



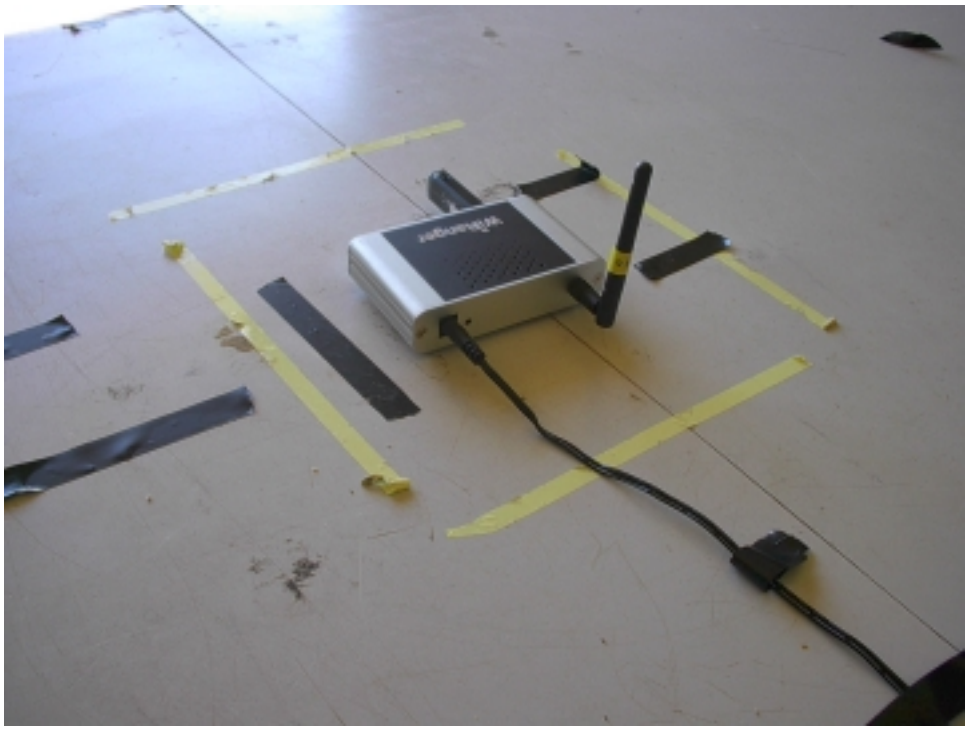
Power Spectral Density – 2462 MHz 18Mbit/sec

Appendix A: EUT Photos

REX Front View - Figure 1

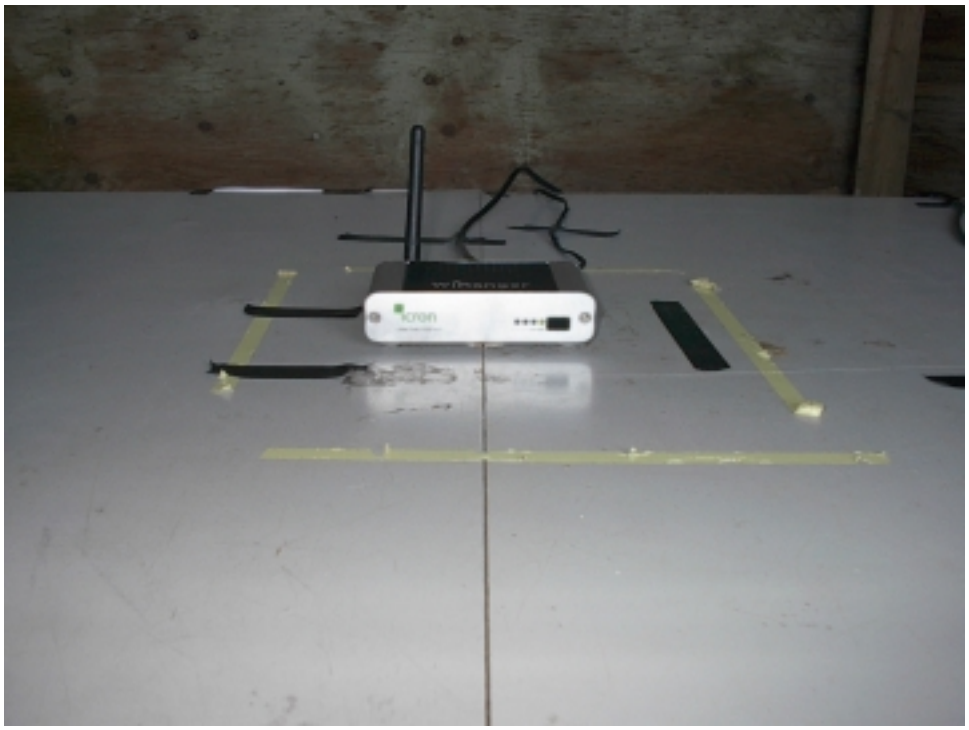


REX Front View Close-up - Figure 2

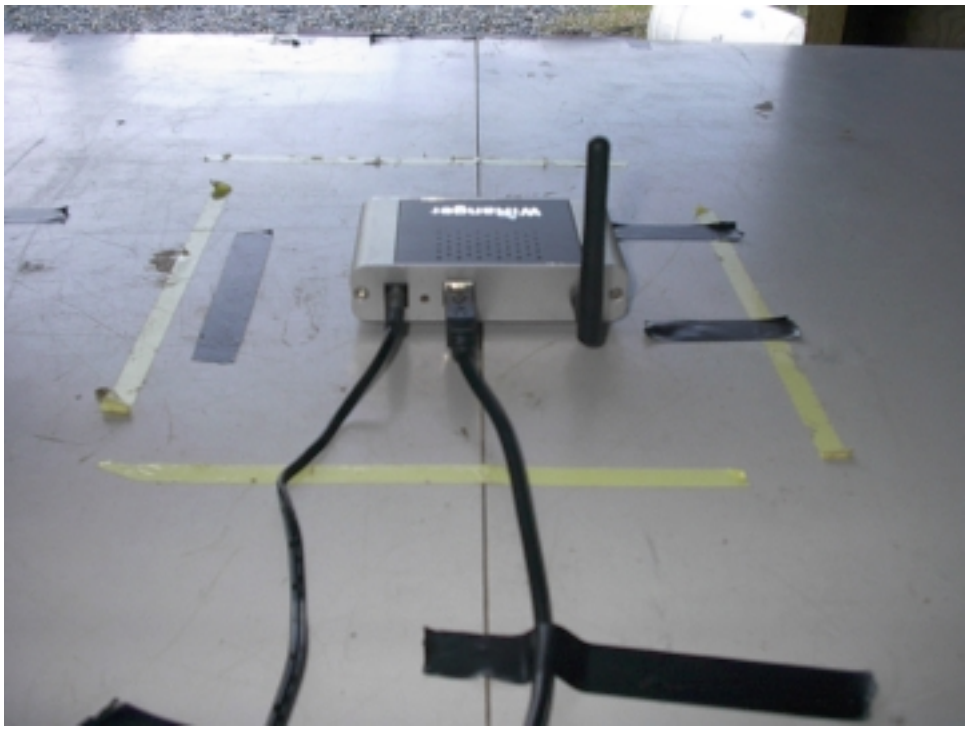


REX Rear View - Figure 3

LEX with USB connected to Laptop Front View - Figure 4



LEX Front View Close-up - Figure 5



LEX Rear View - Figure 6

Appendix B: Measurement Data & Plots

Conducted Emissions - FCC/IC Class B - Standards: FCC Part 15.107, 15.207; IC ICES-003, RSS-210

REX Module using the "Sunny Model:SYS1308-1505-W2" switching power supply.

Table 1: Line 1- Peaks 120Vac, 60Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1582	42.9	-12.6
0.1685	42.0	-13.0
2.2190	32.8	-13.2
0.1624	41.4	-13.9
0.1893	39.7	-14.3
3.8270	31.7	-14.3

Table 2: Line 2- Peaks 120Vac, 60Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1548	44.0	-11.7
0.1650	43.3	-11.9
0.1607	42.1	-13.3
0.1873	40.5	-13.6
1.0520	32.2	-13.8
2.2430	31.9	-14.1

Table 3: Line 1- Peaks 240Vac, 50Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1540	52.8	-2.9
0.1834	48.1	-6.2
0.1590	49.3	-6.2
0.1721	48.3	-6.5
0.1659	48.1	-7.0
0.2173	45.1	-7.8

Table 4: Line 2- Peaks 240Vac, 50Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1703	48.9	-6.0
0.1590	49.4	-6.1
0.1633	49.0	-6.2
0.1873	47.7	-6.4
0.2315	45.8	-6.5
0.1767	47.3	-7.3

LEX Module using "Sunny Model:SYS1308-1505-W2" switching power supply.

Table 5: Line 1- Peaks 120Vac, 60Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1650	44.9	-10.3
0.1598	42.3	-13.1
0.1873	40.9	-13.2
0.3708	35.0	-13.4
2.207	32.0	-14.0
2.493	31.7	-14.3

Table 6: Line 2- Peaks 120Vac, 60Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1659	43.6	-11.5
0.7301	32.7	-13.3
0.3768	34.5	-13.8
2.256	32.1	-13.9
0.1607	41.4	-14.0
1.058	31.9	-14.1

Table 7: Line 1- Peaks 240Vac, 50Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1730	47.6	-7.2
0.1668	47.8	-7.3
0.2072	45.1	-8.2
0.2007	44.3	-9.2
0.1532	46.3	-9.5
0.1796	44.7	-9.8

Table 8: Line 2- Peaks 240Vac, 50Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1685	48.8	-6.2
0.3407	40.6	-8.5
0.1749	45.8	-8.9
0.215	42.2	-10.8
0.2018	42.5	-11.0
0.2685	39.9	-11.2

REX Module using "A Qualities Model:GFP181U-530" switching power supply.

Table 9: Line 1- Peaks 120Vac, 60Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.2007	48.1	-5.4
0.1903	47.8	-6.2
0.3972	36.6	-11.3
1.400	30.9	-15.1
0.1883	38.9	-15.2
0.6003	30.5	-15.5

Table 10: Line 2- Peaks 120Vac, 60Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.2007	49.9	-3.6
0.1954	48.1	-5.7
0.1924	45.9	-8.0
0.4015	37.2	-10.6
1.214	34.1	-11.9
0.6003	33.8	-12.2

Table 11: Line 1- Peaks 240Vac, 50Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1740	47.0	-7.7
0.1864	44.9	-9.2
0.1805	44.2	-10.2
24.930	38.2	-11.8
0.1996	41.8	-11.8
0.2714	39.0	-12.0

Table 12: Line 2- Peaks 240Vac, 50Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1873	43.0	-11.1
0.2574	39.9	-11.6
0.1749	42.7	-12.0
0.2671	38.8	-12.4
0.1944	41.3	-12.5
0.6889	32.7	-13.3

LEX Module using "A Qualities Model:GFP181U-530" switching power supply.

Table 13: Line 1- Peaks 120Vac, 60Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1975	47.0	-6.7
0.1924	46.4	-7.5
0.1854	41.4	-12.8
0.1873	41.0	-13.1
2.3770	32.9	-13.1
0.1903	40.7	-13.3

Table 14: Line 2- Peaks 120Vac, 60Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1996	45.9	-7.7
0.1924	45.5	-8.4
0.3994	38.5	-9.3
1.2070	33.7	-12.3
0.1893	41.3	-12.7
0.5971	33.1	-12.9

Table 15: Line 1- Peaks 240Vac, 50Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1825	46.4	-7.9
0.1767	43.8	-10.8
1.9960	34.5	-11.5
25.600	38.3	-11.7
0.2772	39.0	-11.9
0.1965	41.8	11.9

Table 16: Line 2- Peaks 240Vac, 50Hz

Frequency (MHz)	Peak (dBµV)	DelLim-Pk (dB)
0.1777	45.0	-9.5
0.1703	44.2	-10.7
0.2728	39.2	-11.8
0.4935	32.0	-14.1
0.6035	31.9	-14.1
0.7340	31.9	-14.1

Radiated Emission Criteria: FCC/IC Class B – Tests Performed at 3-m.– using the "Sunny Model:SYS1308-1505-W2" switching power supply.

REX Module – Tested while in Quiescent Transmission Mode.

Table 17: FCC Class B - 3m

Frequency (MHz)	Pol	Hgt (m)	Angle (deg)	Uncor-Pk (dBµV)	Tot Corr (dB)	Peak (dBµV/m)	QP Lmt (dBµV/m)	DelLim-Pk (dB)
60.00000	Vert	1	70	21.0	7.7	28.7	40.0	-11.3
225.01384	Vert	1	170	20.9	12.7	33.6	46.0	-12.4
324.97523	Vert	1	180	24.4	16.4	40.8	46.0	-5.2
540.02618	Horz	2	100	17.0	20.8	37.8	46.0	-8.2
575.00000	Vert	1	300	17.3	21.3	38.6	46.0	-7.4
599.99940	Horz	2	100	21.9	21.6	43.5	46.0	-2.5
625.00396	Horz	2	100	11.2	21.9	33.1	46.0	-12.9
675.00012	Horz	1	100	6.0	23.9	29.9	46.0	-16.1
700.00000	Horz	1	90	6.8	24.6	31.4	46.0	-14.6

Table 18: ICES-003 Class B – 3m

Frequency (MHz)	Pol	Hgt (m)	Angle (deg)	Uncor-Pk (dBµV)	Tot Corr (dB)	Peak (dBµV/m)	QP Lmt (dBµV/m)	DelLim-Pk (dB)
60.00000	Vert	1	70	21.0	7.7	28.7	39.5	-10.8
225.01384	Vert	1	170	20.9	12.7	33.6	39.5	-5.9
324.97523	Vert	1	180	24.4	16.4	40.8	46.5	-5.7
540.02618	Horz	2	100	17.0	20.8	37.8	46.5	-8.7
575.00000	Vert	1	300	17.3	21.3	38.6	46.5	-7.9
599.99940	Horz	2	100	21.9	21.6	43.5	46.5	-3.0
625.00396	Horz	2	100	11.2	21.9	33.1	46.5	-13.4
675.00012	Horz	1	100	6.0	23.9	29.9	46.5	-16.6
700.00000	Horz	1	90	6.8	24.6	31.4	46.5	-15.1

LEX Module – Tested while in Quiescent Transmission Mode

Table 19: FCC Class B - 3m

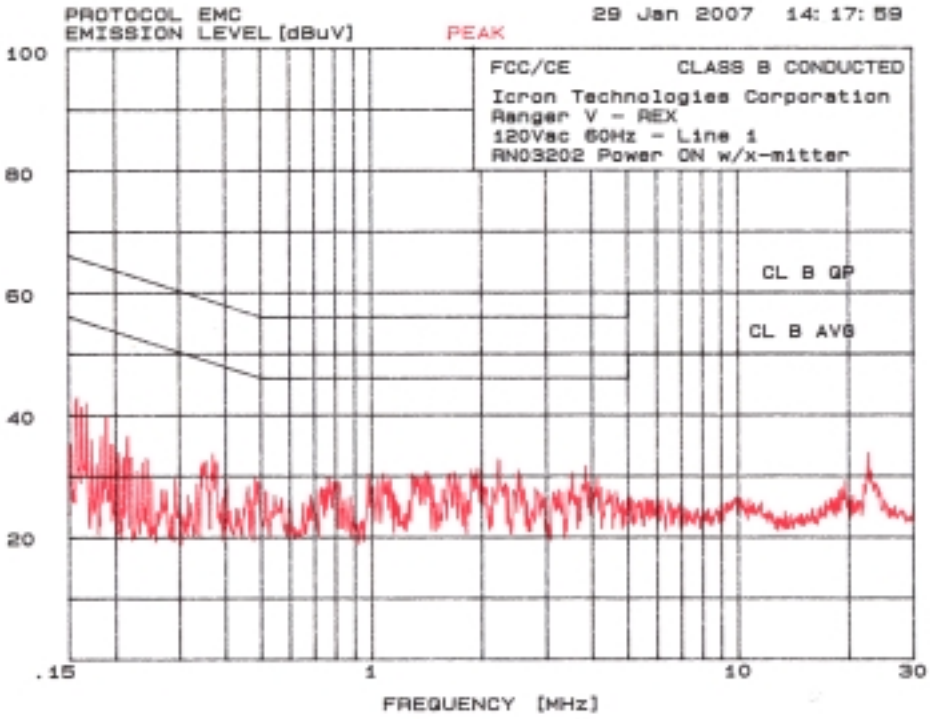
Frequency (MHz)	Pol	Hgt (m)	Angle (deg)	Uncor-Pk (dBµV)	Tot Corr (dB)	Peak (dBµV/m)	QP Lmt (dBµV/m)	DelLim-Pk (dB)	QP (dBµV/m)	DelLim-QP (dB)
60.00000	Vert	1	230	31.6	7.7	39.3	40.0	-0.7	30.3	-9.7
180.00000	Horz	1	270	14.5	8.4	22.9	43.5	-20.6		
200.00000	Horz	2	270	20.9	8.5	29.4	43.5	-14.1		
250.00000	Horz	1	250	20.7	14.0	34.7	46.0	-11.3		
300.00000	Horz	1	100	23.5	16.4	39.9	46.0	-6.2		
360.00000	Horz	1	0	15.5	17.3	32.8	46.0	-13.2		
900.00000	Horz	1	290	14.6	26.5	41.1	46.0	-4.9		
1020.00000	Vert	1	0	11.7	28.4	40.1	54.0	-13.9		

Table 20: ICES-003 Class B – 3m

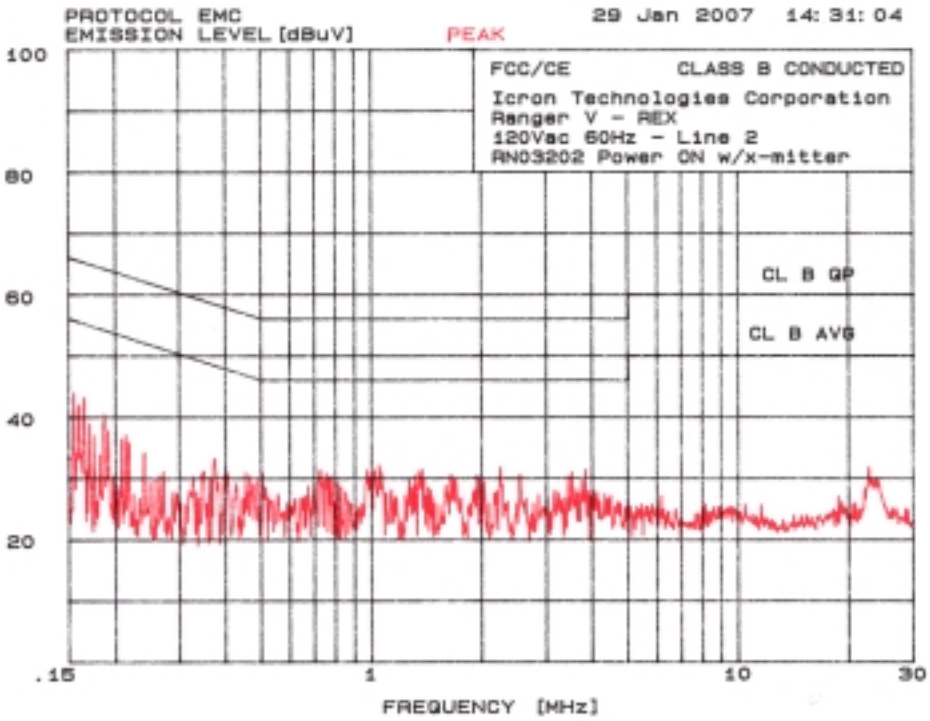
Frequency (MHz)	Pol	Hgt (m)	Angle (deg)	Uncor-Pk (dBµV)	Tot Corr (dB)	Peak (dBµV/m)	QP Lmt (dBµV/m)	DelLim-Pk (dB)	QP (dBµV/m)	DelLim-QP (dB)
60.00000	Vert	1	230	31.6	7.7	39.3	39.5	-0.2	30.3	-9.2
180.00000	Horz	1	270	14.5	8.4	22.9	39.5	-16.6		
200.00000	Horz	2	270	20.9	8.5	29.4	39.5	-10.1		
250.00000	Horz	1	250	20.7	14.0	34.7	46.5	-11.8		
300.00000	Horz	1	100	23.5	16.4	39.9	46.5	-6.7		
360.00000	Horz	1	0	15.5	17.3	32.8	46.5	-13.7		
900.00000	Horz	1	290	14.6	26.5	41.1	46.5	-5.4		
1020.00000	Vert	1	0	11.7	28.4	40.1	56.0	-15.9		

Conducted Emissions Plots

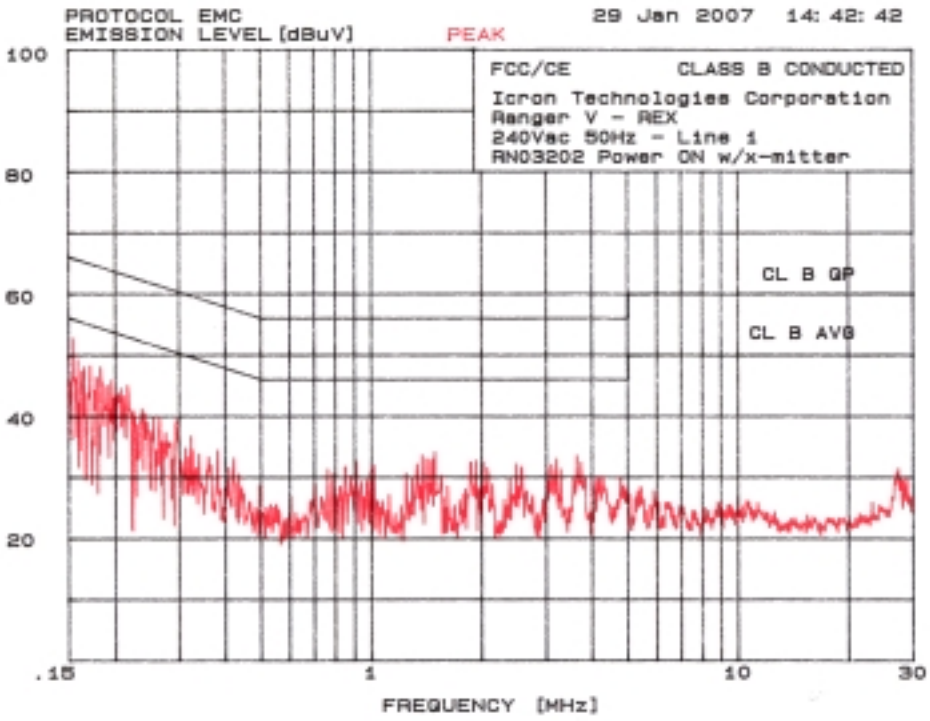
REX Module using the "Sunny Model:SYS1308-1505-W2" switching power supply.



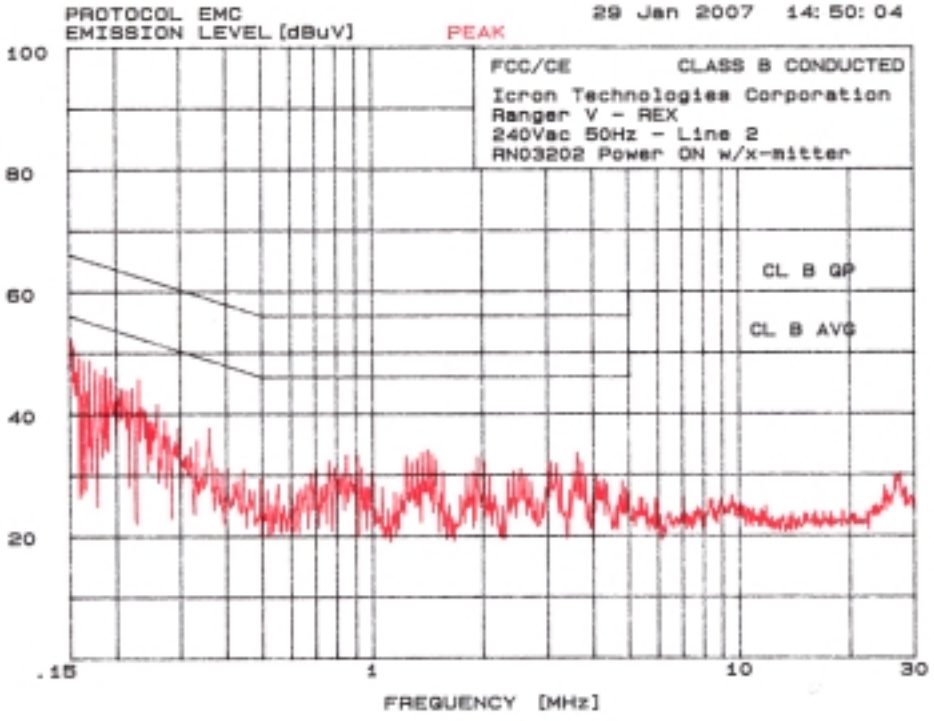
Plot 1 – Line 1 – 120Vac, 60Hz Line



Plot 2 - Line 2 – 120Vac, 60Hz Neutral



Plot 3 – Line 1 – 240Vac, 50Hz Line



Plot 4 - Line 2 – 240Vac, 50Hz Neutral

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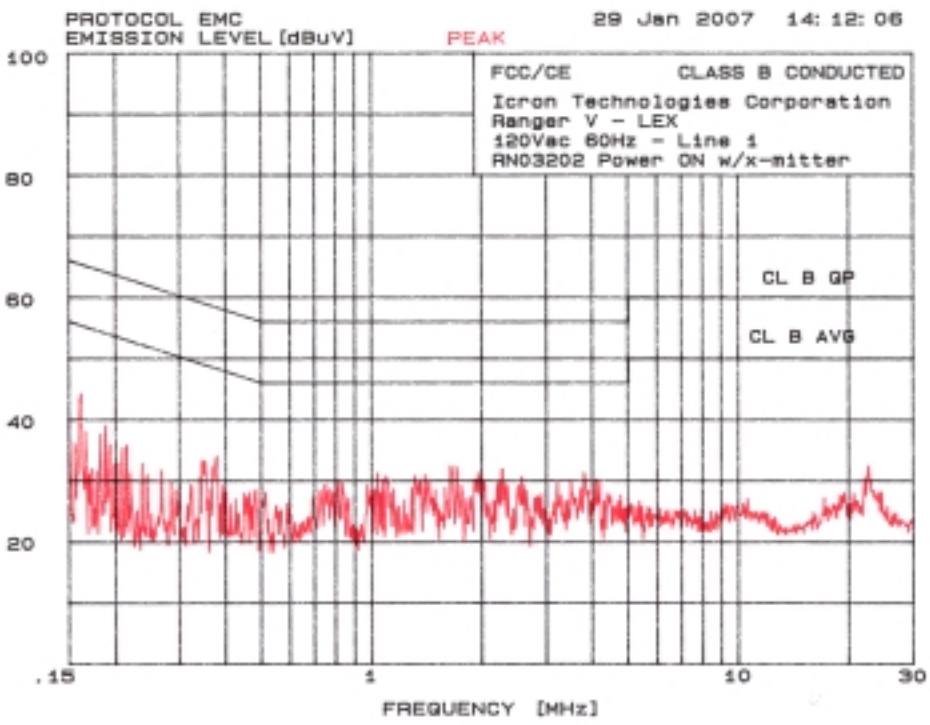
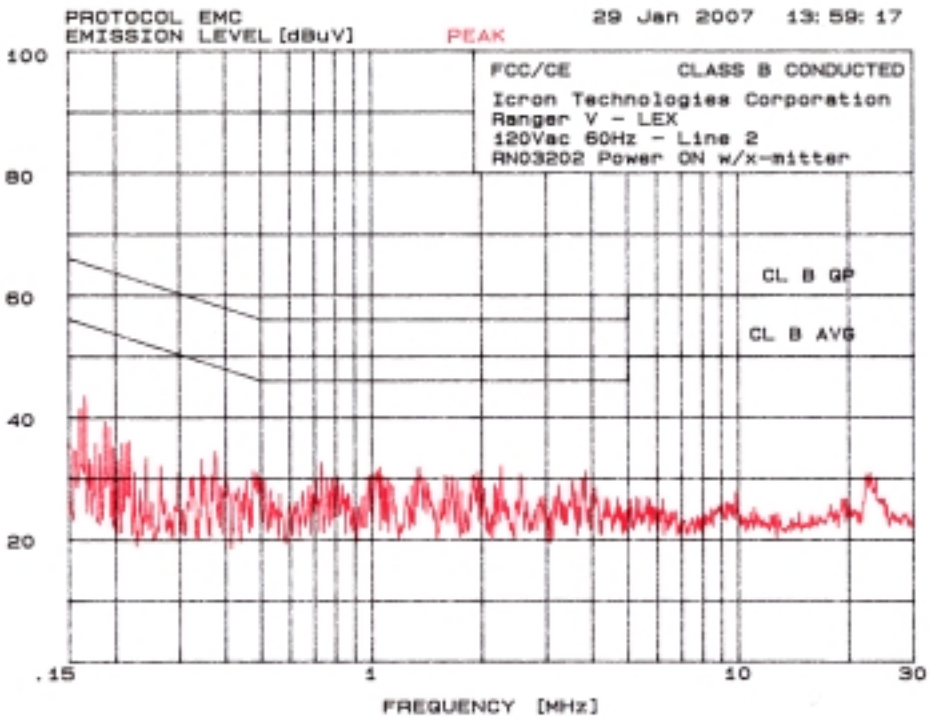
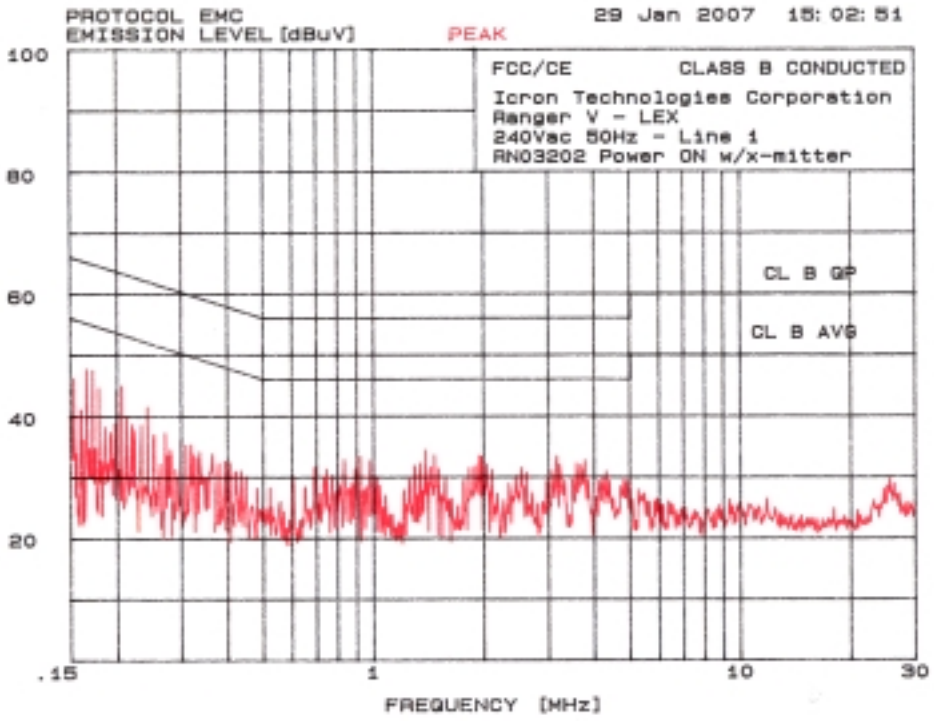
LEX Module using the "Sunny Model:SYS1308-1505-W2" switching power supply



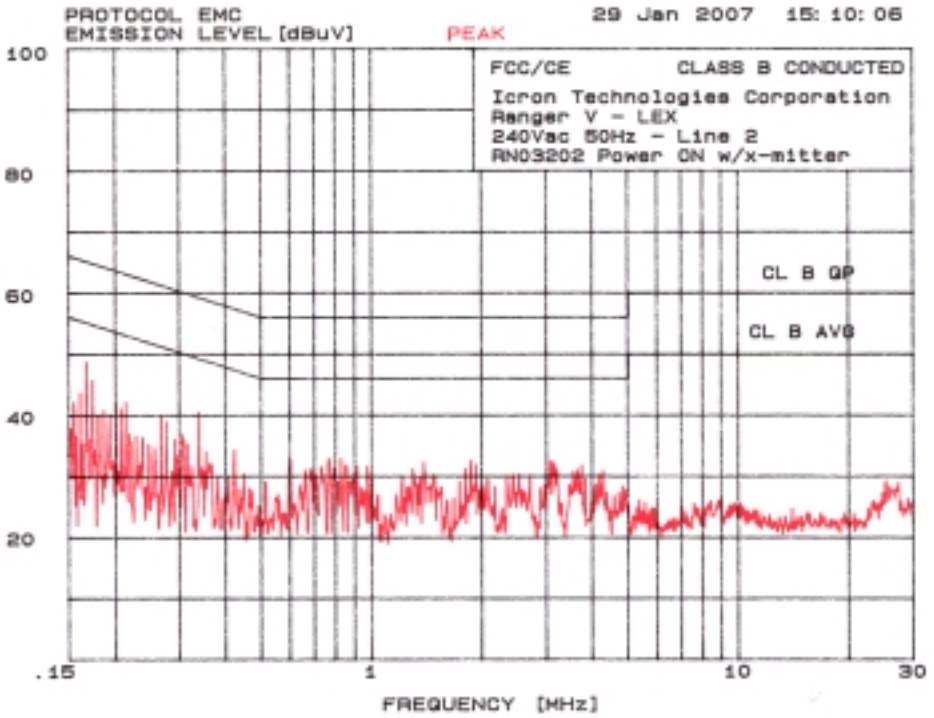
Plot 5 – Line 1 – 120Vac, 60Hz Line



Plot 6 - Line 2 – 120Vac, 60Hz Neutral

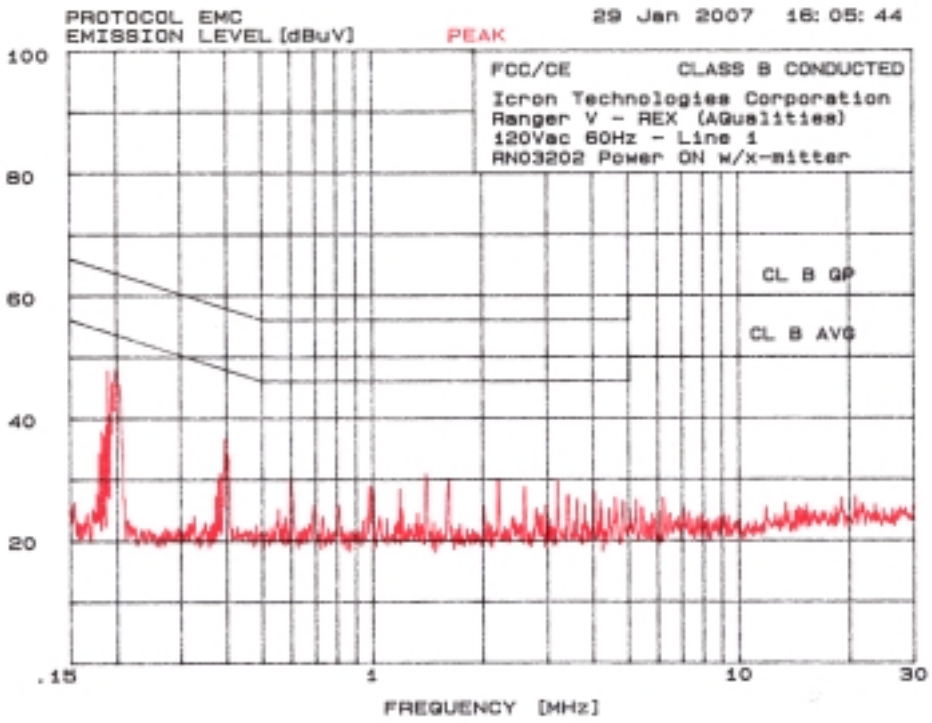


Plot 7 – Line 1 – 240Vac, 50Hz Line

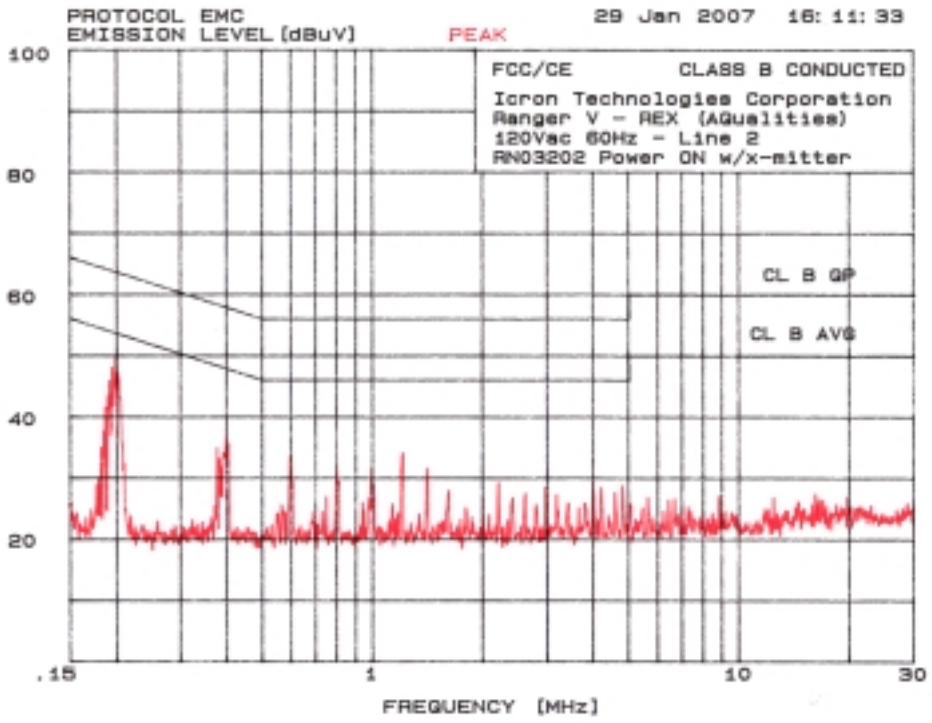


Plot 8 - Line 2 – 240Vac, 50Hz Neutral

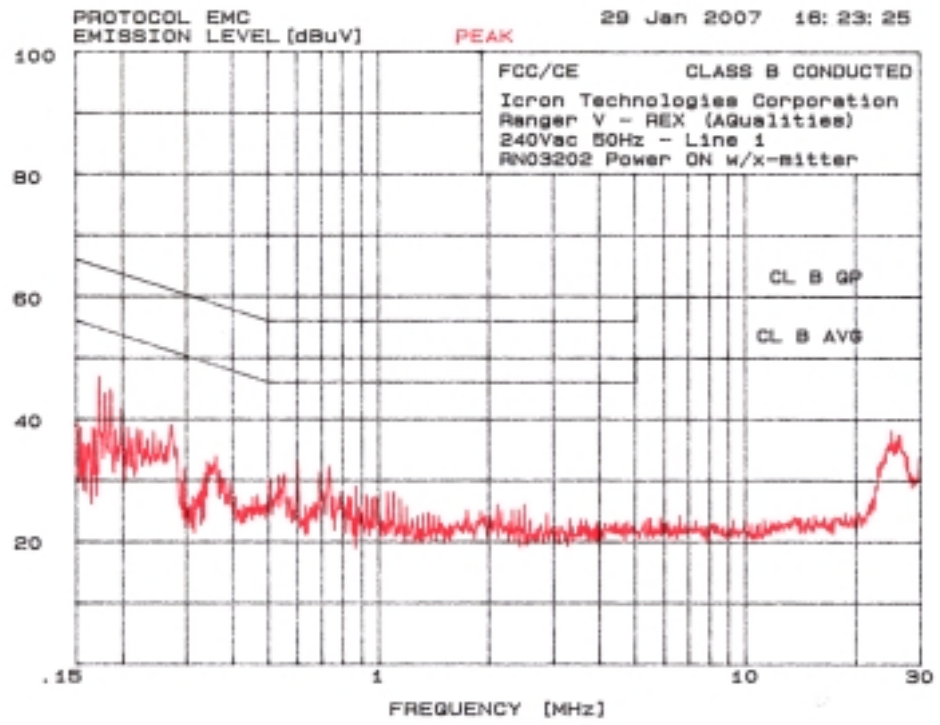
REX Module using the "Aqualities GFP181U-530" switching power supply.



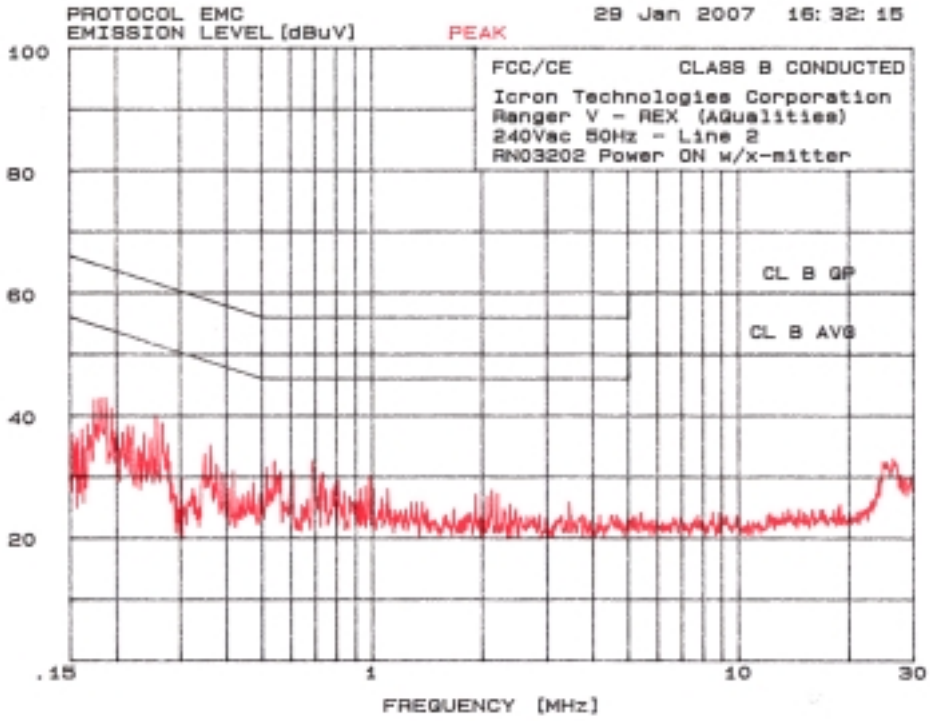
Plot 9 – Line 1 – 120Vac, 60Hz Line



Plot 10 - Line 2 – 120Vac, 60Hz Neutral

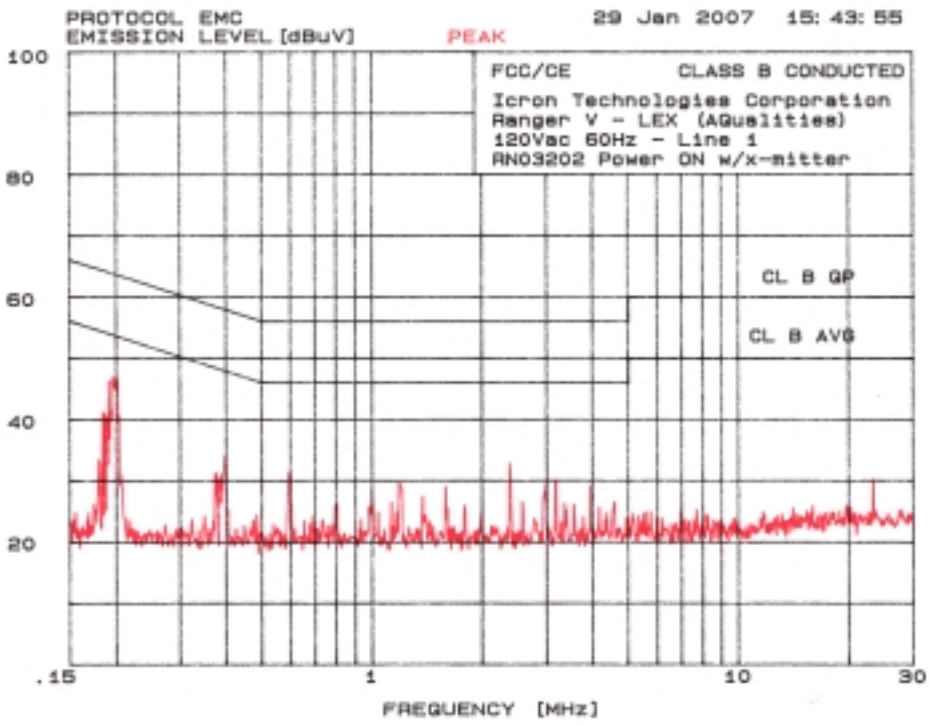


Plot 11 – Line 1 – 240Vac, 50Hz Line

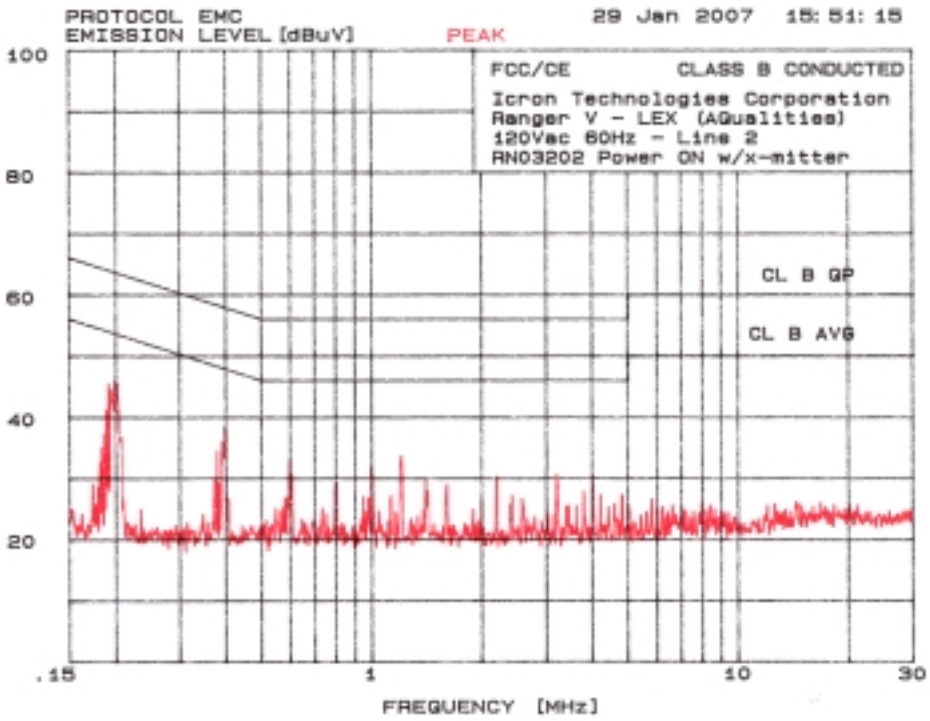


Plot 12 - Line 2 – 240Vac, 50Hz Neutral

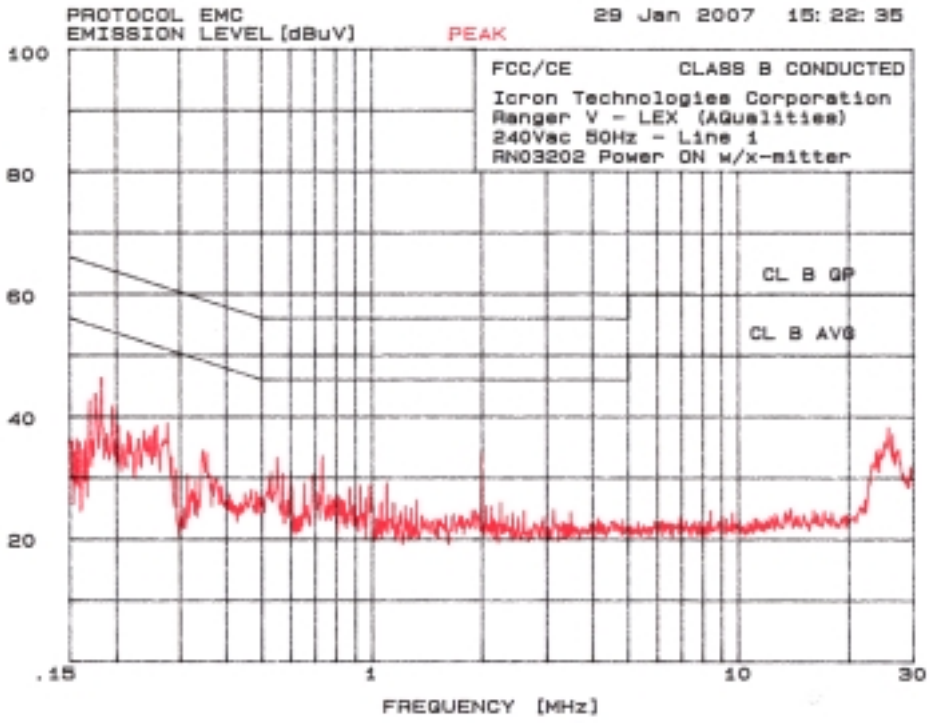
LEX Module using the "Aqualities GFP181U-530" switching power supply.



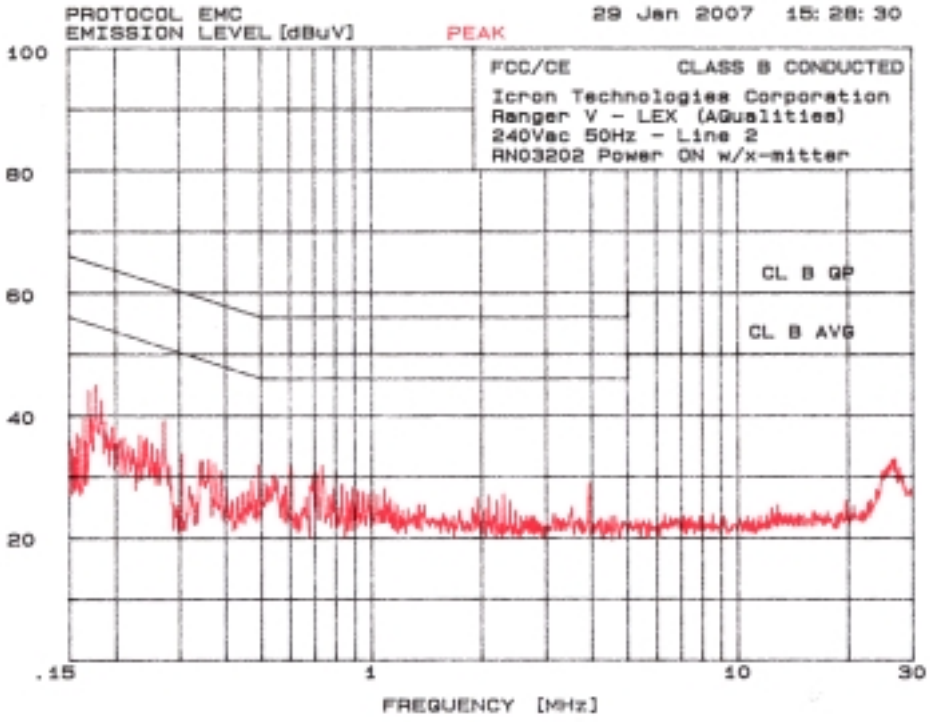
Plot 13 – Line 1 – 120Vac, 60Hz Line



Plot 14 - Line 2 – 120Vac, 60Hz Neutral



Plot 15 – Line 1 – 240Vac, 50Hz Line



Plot 16 - Line 2 – 240Vac, 50Hz Neutral