REPORT OF MEASUREMENTS

DEVICE:	902 – 928 MHz 21 CHANNEL DIRECT SEQUENCE SPREAD SPECTRUM WIRELESS ROUTER BRIDGE
MODEL:	EUM3000
MANUFACTURER:	WAVERIDER COMMUNICATIONS (CANADA) INC.
ADDRESS:	6120 – 1A STREET S.W. CALGARY ALBERTA CANADA T2H 0G3

WORK ORDER: 9181HR

American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC GUIDE 25-1990 (EN45001)

ACME TESTING
2002 Valley Highway
Acme, WA 98220-0003
Steve Fitzgerald Phone: 360 595 2785

ELECTRICAL (EMC)

Valid to: November 30, 2001 Certificate Number: 0829-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following Electromagnetic Compatibility (EMC) tests:

Radiated & Conducted Emissions
Immunity
Voltage sags
Harmonics
Flicker

On the following materials and products:
Electrical and electronic equipment for information technology; industrial, scientific, and medical applications; residential service; receivers; and licensed and unlicensed transmitters.

Using the following standards:
U.S. Code of Federal Regulations (CFR) 47, FCC Method Parts 15 (using ANSI C63.4-1992), 18 & 90
CISPR: 11; 13; 14 (*excluding click measurements*); 22 (*including Amendments 1 and 2*)
CNS: 13439; 13438
EN: 50081-1; 50081-2; 50082-1; 50082-2; 55011; 55013; 55014-1 (*excluding click measurements*); 55014-2; 55022; 55103-1; 55103-2; 60601-1-2; 60945 (*sections 9 & 10 only*); 61000-4-2; 61000-4-3; 61000-4-4; 61000-4-5 (*single phase only, excluding 10/700 surge testing*); 61000-4-6; 61000-4-8; 61000-4-11; 61000-3-2; 61000-3-3
AS/NZS: 3548, 2064.1/2, 4251.1, 4252.1
IEC: 801-2; 801-3; 801-4; 801-5; 1000-4-2; 1000-4-3; 1000-4-4; 1000-4-5; 1000-4-6
ENV: 50140; 50204
ICES-003 Issue 2 Revision 1
RSS-210 Issue 2
Bellcore GR-1089-CORE (*Sections 2 through 3.2.4*)

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8370 • Phone: 301 644 3248 • Fax: 301 662 2974

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1. General

1.1 Document History

REVISION	DATE	COMMENTS
-	7 February 2001	Initial Release, Paul G. Slavens

Note: Acme Testing Co. hereby makes the following statements so as to conform with Chapter 10 (Test Reports) Requirement of ANSI C63.4:1992 "Methods and Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz":

- The units described in this report were received at Acme Testing Co.'s facilities and testing was performed on the units described in this report on 19, 21, 22, & 28 December 2000.
- The Test Results reported herein apply only to the Units actually tested, and to substantially identical Units.
- This test report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government, or any other foreign government.

1.2 Purpose

The purpose of this report is to show compliance to the FCC regulations for spread spectrum unlicensed devices operating under section 15.247 of the Code of Federal Regulations title 47.

THE DATA CONTAINED IN THIS REPORT WAS COLLECTED AND COMPILED BY:

PAUL G. SLAVENS CHIEF EMC ENGINEER	DANIEL B. STATON EMC TECHNICIAN

1.3 Manufacturer

Company Name:	WaveRider Communications (Canada) Inc.
Contact:	Ivan Rodrigues
Street Address:	6120 – 1A Street S.W.
City/Province:	Calgary Alberta
Country/Postal Code:	Canada T2H 0G3
Telephone:	403 319-2350
Fax:	403 319-2359

1.4 Test location

Laboratory:	Test Site #1
Street Address:	2002 Valley Highway
Mailing Address:	PO Box 3
City/State/Zip:	Acme WA 98220-0003
Telephone:	888 226-3837
Fax:	360 595-2722
E-mail:	acmetest@acmetesting.com
Web:	www.acmetesting.com

1.5 Accreditation and Listing

Acme Testing Co.'s test facilities are accredited by A2LA for the specific scope of accreditation under Certificate Numbers: 0829-01 (Acme, WA), and 0829-02 (Plummer, ID). Acme Testing Co.'s test facilities that are used to perform radiated and conducted emissions are currently registered with the Federal Communications Commission under registration numbers: 90420 (Acme, WA), and 96502 (Plummer, ID). In addition test facilities are also registered with the Industry Canada under registration numbers: 3251 (Acme, WA), and 3618 (Plummer, ID).

2. Test Results Summary

Summary of Test Results

Requirement	CFR Section	Test Result
Radiated Spurs < 15.209	15.205(b)	PASS
AC Emissions < 48 dBuV	15.207	PASS
6 dB BW > 500 kHz	15.247(a)	PASS
Max Output Power < 1 W	15.247(a)	PASS
Antenna Gain Requirements	15.247(b)	PASS
Radio Frequency Exposure	15.247(b)	PASS
Conducted Spurious >-20 dBc	15.247(c)	PASS
Power Density < 8dBm in 3 kHz	15.247(d)	PASS
Process Gain > 10 dB	15.247(e)	PASS

The signed original of this report, supplied to the client, represents the only "official" copy. Retention of any additional copies (electronic or non-electronic media) is at Acme Testing Co.'s discretion to meet internal requirements only. The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units, and meet the requirements of the specifications referenced herein.

Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) is factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.

The measurements contained in this report were made in accordance with the referenced standards and all applicable Public Notices received prior to the date of testing. Acme Testing Co. assumes responsibility only for the accuracy and completeness of this data as it pertains to the sample tested.

_____ _____

Paul G. Slavens — Date of Issuance
Chief EMC Engineer

3. Description of Equipment and Peripherals

3.1 Equipment Under Test (EUT)

Device:	902 – 928 MHz 21 Channel Direct sequence Spread Spectrum Wireless Router/Bridge
Model Number:	EUM3000
FCC ID:	OOX-LMS3000
Power:	120 V/60 Hz
Grounding:	3-Wire AC Plug
Antennas:	Yagi, Omni-directional, Disk, Patch, & Dipole
Number of Channels:	21
Lowest Frequency:	905 MHz
Highest Frequency:	925 MHz

3.2 Mode of Operation During Testing

The EUT was exercised by transmitting a modulated signal on channels 1, 11, & 21. During radiated spurious emission testing the EUT was tested with five (Omni directional, Disk, Patch, Yagi, & Dipole) antennas.

3.3 Modifications Required for Compliance

1. None.

3.4 EUT Peripherals for Emissions

Device	Manufacturer	Model Number	FCC ID	Serial Number
Laptop Computer	Compaq	Series 292OA	DGIP5665	None
Power Supply	Acbel Polytech Inc.	APIOAD56-000	None	000044

3.5 Description of Interface Cables for Emissions

CPU and Transmitter Unit/Omni directional Antenna

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	0.35 m	No

CPU and Transmitter Unit/Disk Antenna

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	3.6 Bundled	No

CPU and Transmitter Unit/Patch Antenna

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	0.25 m	No

CPU and Transmitter Unit/Yagi Antenna

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	0.35 m	No

CPU and Transmitter Unit/Dipole Antenna

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	10.5 m Coiled	No

CPU and Transmitter Unit/Laptop Computer (RS-232 cable)

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	1.3 m	No

CPU and Transmitter Unit/Laptop Computer (CAT 5 cable)

Shielded	Unshielded	Flat	Round	Length	Ferrite
No	Yes	No	Yes	1 m	No

CPU and Transmitter Unit/Power Supply

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	2 m	No

ARRANGEMENT OF INTERFACE CABLES: All interface cables were positioned for worst case maximum emissions within the manner assumed to be a typical operation condition (please reference photographs).

4. Antenna requirement

4.1 Regulation

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.

4.2 Result

The intentional radiator uses a propriety connector QMI part number WAVRPCAJ M0D1.

5. Conducted Emissions Tests

Test Requirement: FCC CFR47, Part 15C

Test Procedure: ANSI C63.4:1992, (FCC CFR47 15.207)

Date of Test: 19 December 2000

Laboratory: Test Site #1 (Acme, WA)

5.1 Test Equipment

⇒ Spectrum Analyzer (yellow): Hewlett-Packard 8566B, Serial Number 2403A06519, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ Quasi Peak Adapter (yellow): Hewlett-Packard 85650A, Serial Number 2521A-00689, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ Line Impedance Stabilization Network: EMCO 3825/2, Serial Number 9002-1601, Calibrated: 2 January 2000, Calibration due Date: 2 January 2001

5.2 Purpose

The purpose of this test is to evaluate the level of conducted noise the EUT imposes on the AC mains.

5.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that is placed above the groundplane. Floor standing equipment is placed directly on the groundplane. Any supplemental grounding mechanisms are connected, if appropriate. The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter. The EUT is connected to a dedicated LISN and all peripherals are connected to a second separate LISN circuit. The LISNs are bonded to the groundplane.

Preview tests are performed to determine the “worst case” mode of operation. With the EUT operating in “worst case” mode, final conducted measurements are taken. Conducted measurements are made on each current carrying conductor with respect to ground.

Conducted Emissions Test Characteristics	
Frequency range	0.45 MHz - 30.0 MHz
Test instrumentation resolution bandwidth	9 kHz
Lines Tested	Line 1/Line 2

5.4 Test Results

A summary of the highest amplitude emissions from 0.45 MHz – 30 MHz are listed below.

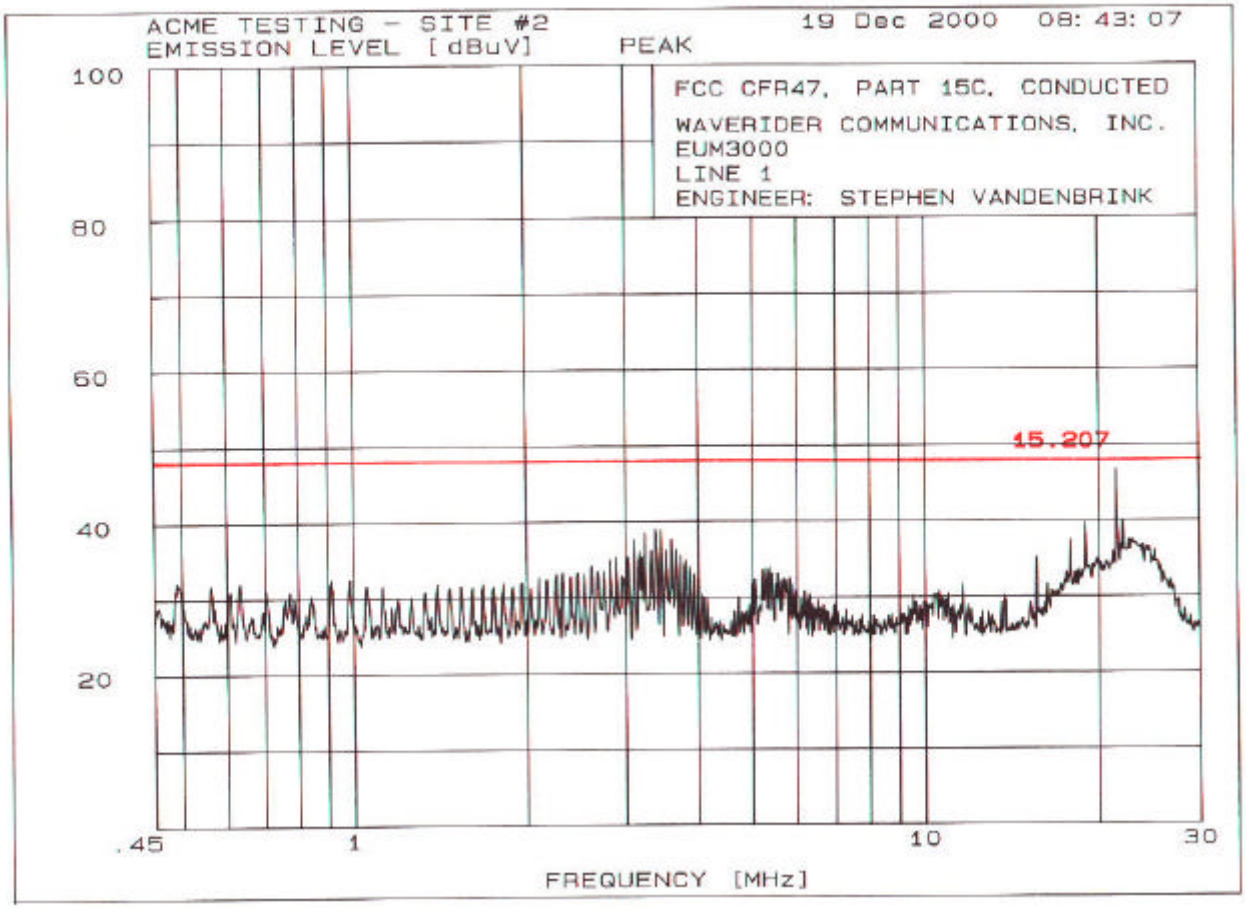
LINE 1
PEAK EMISSIONS

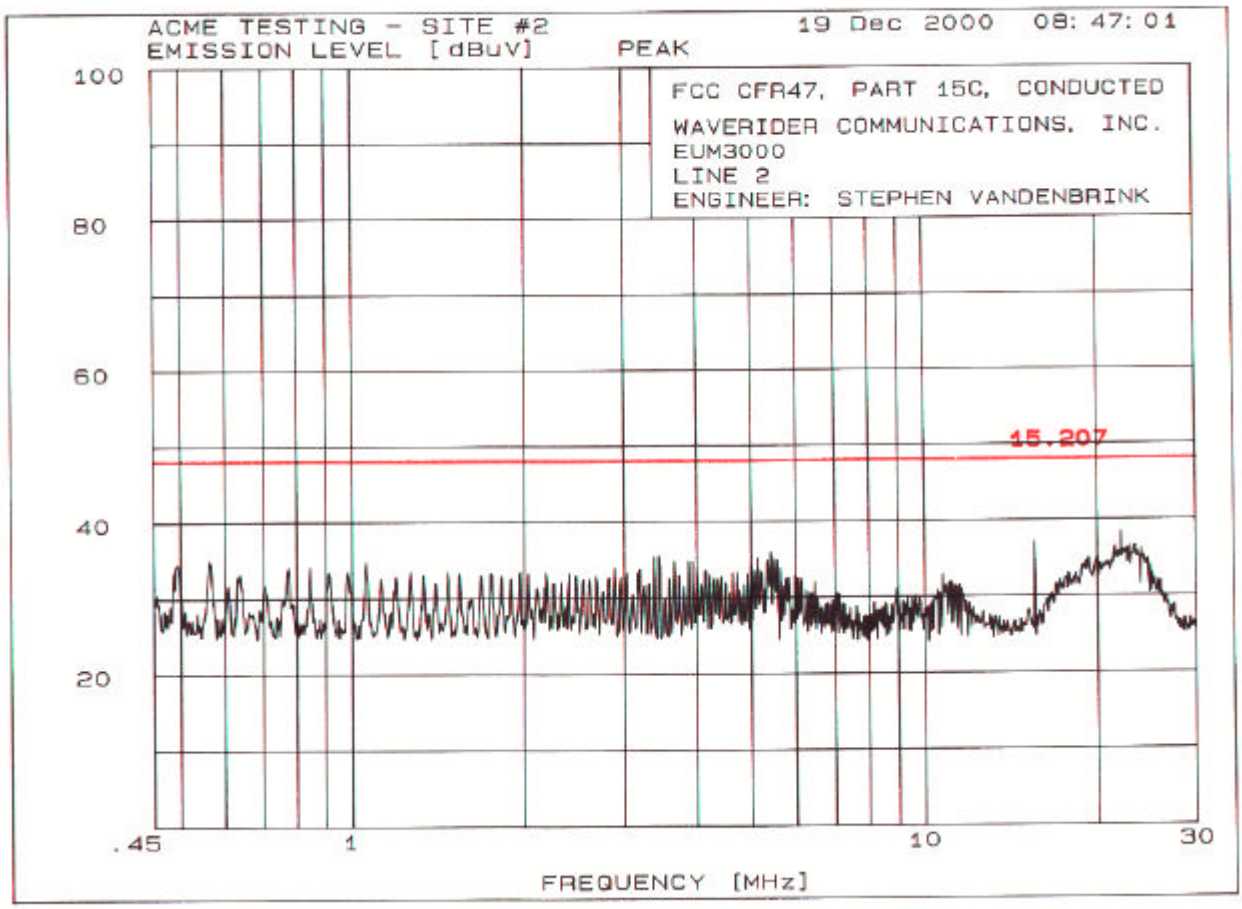
PEAK #	FREQ. (MHz)	AMPL (dBuV)
1	3.1	37.6
2	3.233	38.5
3	3.371	39.0
4	3.443	38.8
5	3.59	37.6
6	18.91	39.6
7	21.45	46.7

LINE 2
PEAK EMISSIONS

PEAK #	FREQ. (MHz)	AMPL (dBuV)
1	3.386	35.4
2	3.443	35.5
3	5.129	35.2
4	5.416	35.9
5	15.59	37.1
6	21.99	38.4

5.5 Graphical Data




ACME TESTING - SITE #2
EMISSION LEVEL [dBuV]
PEAK
19 Dec 2000 08: 47: 01
FCC CFR47, PART 15C, CONDUCTED
WAVERIDER COMMUNICATIONS, INC.
EUM3000
LINE 2
ENGINEER: STEPHEN VANDENBRINK
15.207
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

6. 6 dB Bandwidth

6.1 Regulation

15.247(a2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

6.2 Test Equipment

⇒ Spectrum Analyzer (yellow): Hewlett-Packard 8566B, Serial Number 2403A06519, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

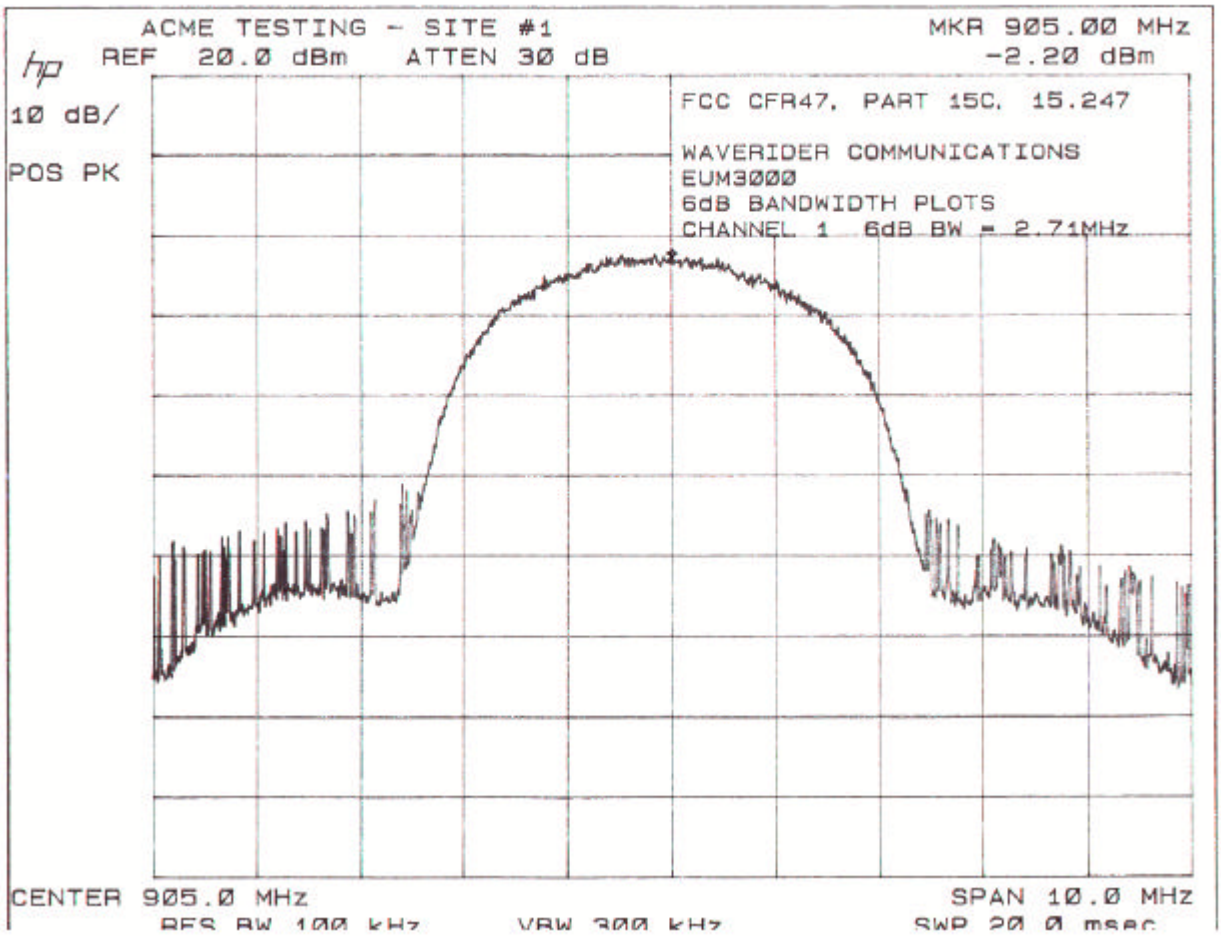
6.3 Test Procedures

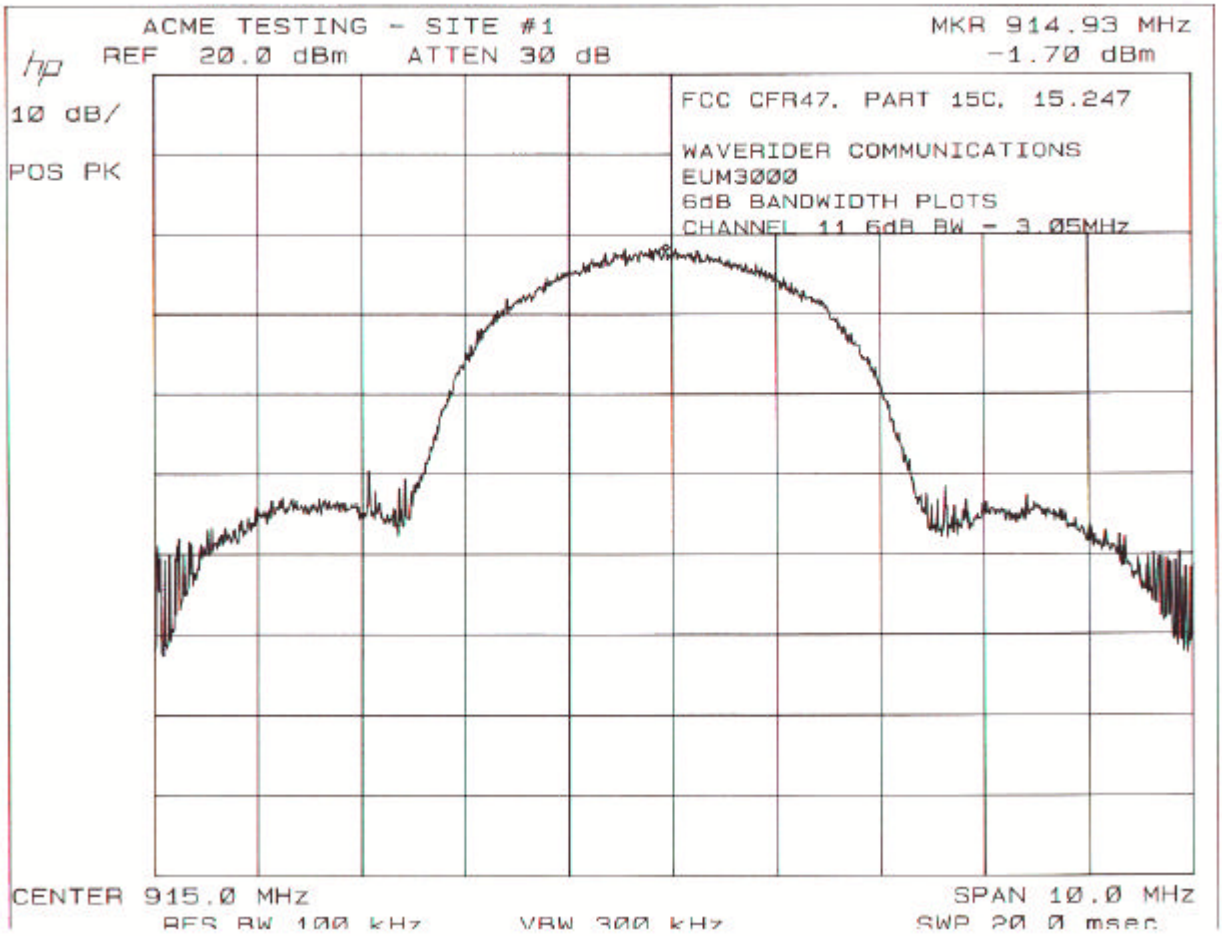
The RF output of the EUT is connected to the RF input port of the RF preselector through a 10 dB pad. The following measurements were made with a RBW = 100 kHz and VBW = 300 KHz.

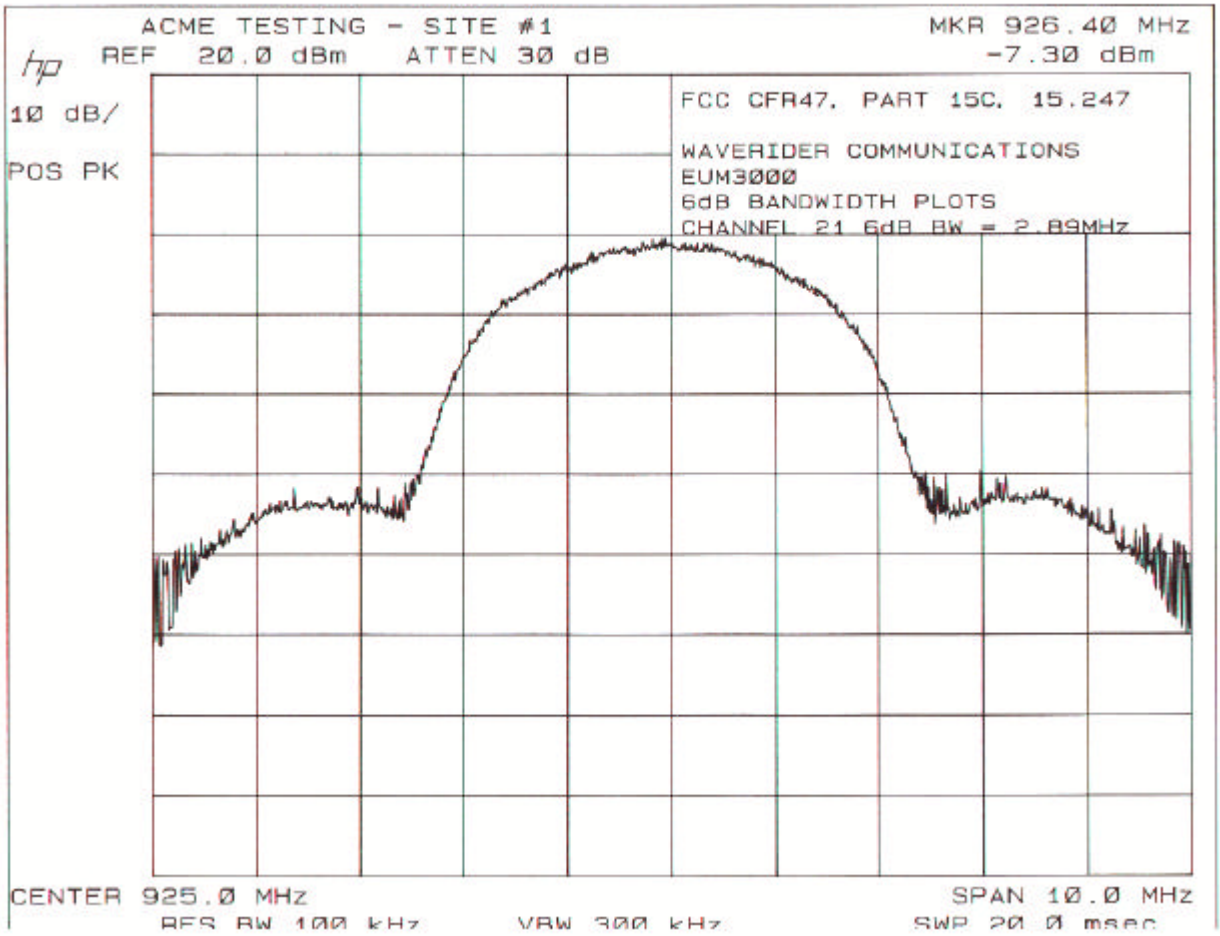
6.4 Test Results

⇒ The measured 6 dB bandwidth at channel 1 is 2.71 MHz.
⇒ The measured 6 dB bandwidth at channel 11 is 3.05 MHz.
⇒ The measured 6 dB bandwidth at channel 21 is 2.89 MHz.

6.5 Graphical Data




ACME TESTING - SITE #1
MKR 914.93 MHz
REF 20.0 dBm
ATTEN 30 dB
-1.70 dBm
10 dB/
POS PK
FCC CFR47. PART 15C. 15.247
WAVERIDER COMMUNICATIONS
EUM3000
6dB BANDWIDTH PLOTS
CHANNEL 11 6dB BW - 3.05MHz
CENTER 915.0 MHz
SPAN 10.0 MHz
RES BW 100 kHz
VBW 300 kHz
SWP 20.0 msec


ACME TESTING - SITE #1
MKR 926.40 MHz
REF 20.0 dBm
ATTEN 30 dB
-7.30 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
6dB BANDWIDTH PLOTS
CHANNEL 21 6dB BW = 2.89MHz
CENTER 925.0 MHz
SPAN 10.0 MHz
RES BW 100 kHz
VBW 300 kHz
SWP 20.0 msec

7. Power Output

7.1 Regulation

15.247(b1) The maximum peak output power of the intentional radiator shall not exceed the following: For frequency hopping systems operating in the 2400-2483.5 MHz or 5725-5850 MHz band and for all direct sequence systems: 1 watt.

7.2 Test Equipment

⇒ Spectrum Analyzer (yellow): Hewlett-Packard 8566B, Serial Number 2403A06519, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

7.3 Test Procedures

The modulated RF output of the EUT is connected to the RF input port of the RF preselector. The following measurements were made with a RBW = 3 MHz and VBW = 3 MHz.

7.4 Test Results

⇒ Measured maximum Peak Envelope Power for channel 1 was 25.6 dBm.
⇒ Measured maximum Peak Envelope Power for channel 11 was 25.6dBm.
⇒ Measured maximum Peak Envelope Power for channel 21 was 25.6 dBm.

8. Antenna gain requirements

8.1 Regulation

15.247(b3) Except as shown below, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the above stated values by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

1 Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas 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 exceeds 6 dBi.

(ii) Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omni directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

8.2 Result

The transmitter is professionally installed. Appendix C of the users manual gives instructions to the professional installer to ensure that the antenna system gain does not exceed 10.4 dBi.

9. Radio Frequency exposure

9.1 Regulation

15.247(b4) 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.

9.2 Result

According to par 1.1307b(1), the EUT does not require an environmental evaluation.

1. This equipment classification is not present within table 1 of part 1.1307 and is not listed in section 1.1307b(2).
2. The EUT categorically exempt from routine environmental evaluation per section 2.1093.

Included are calculations that determine that minimum distance I from the transmitter antenna that will ensure an exposure limit at or below the guidelines given in table 1 of part 1.1310 for the general population. The formula for these calculations are taken from OET Bulletin 65, edition 97-01, August 1997; "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields".

9.3 CALCULATIONS

Per Table 1 of Section 1.1310 the limit for general population exposure at 2.4 GHz is 1.0 mW/cm^2

Per OET Bulletin 65, edition 97-01 the formula for calculating power density is:
$S = P*G/4\pi R^2$
with
Power = 25.6 dBm = 363 mW
Gain of Antenna: System = 10.4 dBi or a numeric gain of 11
therefore
Solving for R gives a minimum safe distance of 17.8 cm

9.4 CONCLUSION

Page 19 of the user manual instructs the installer to maintain at least a 2 meter separation between personal and the user.

10. Conducted Spurious Emissions

10.1 Regulation

15.247 I In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

10.2 Test Equipment

⇒ Spectrum Analyzer (yellow): Hewlett-Packard 8566B, Serial Number 2403A06519, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ Quasi Peak Adapter (yellow): Hewlett-Packard 85650A, Serial Number 2521A-00689, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

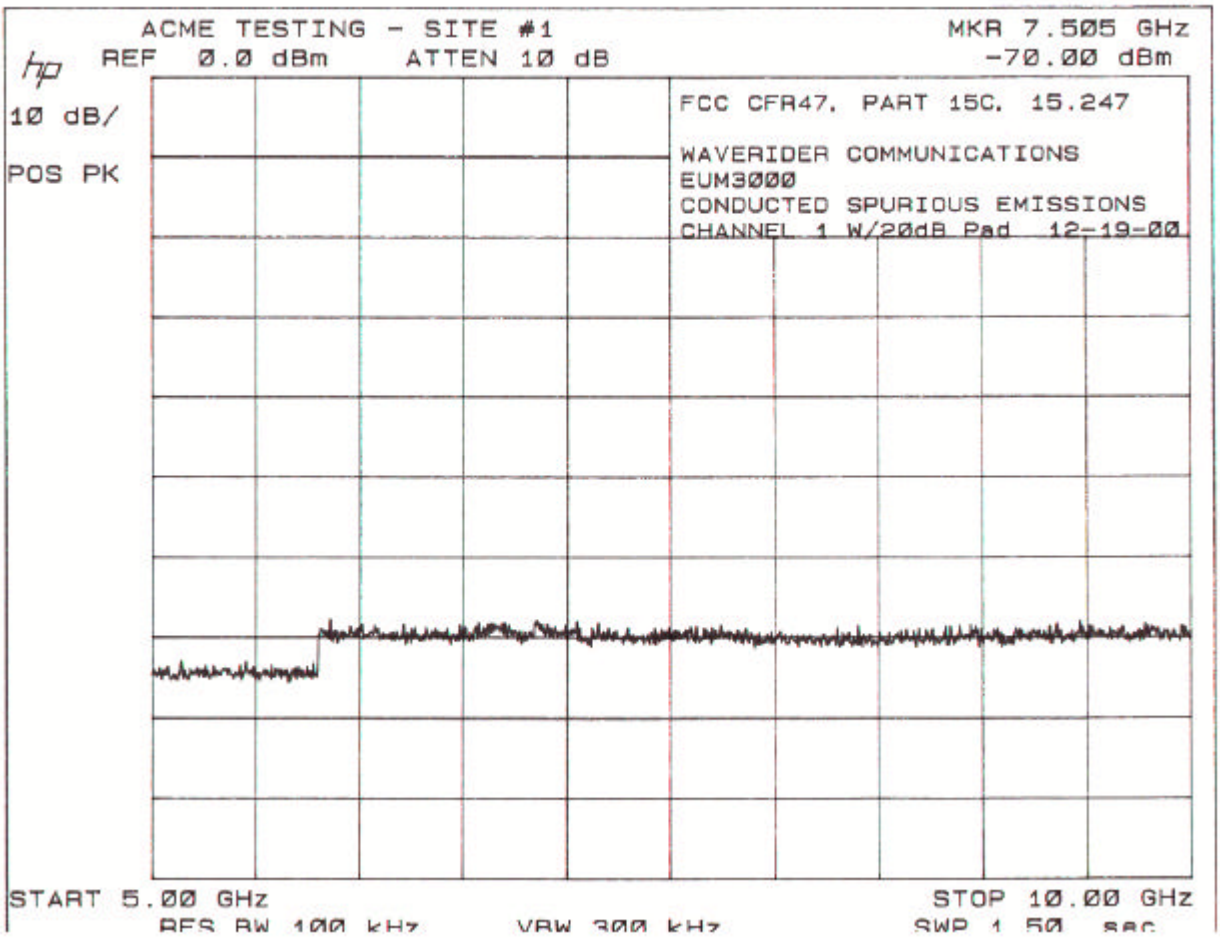
10.3 Test Procedures

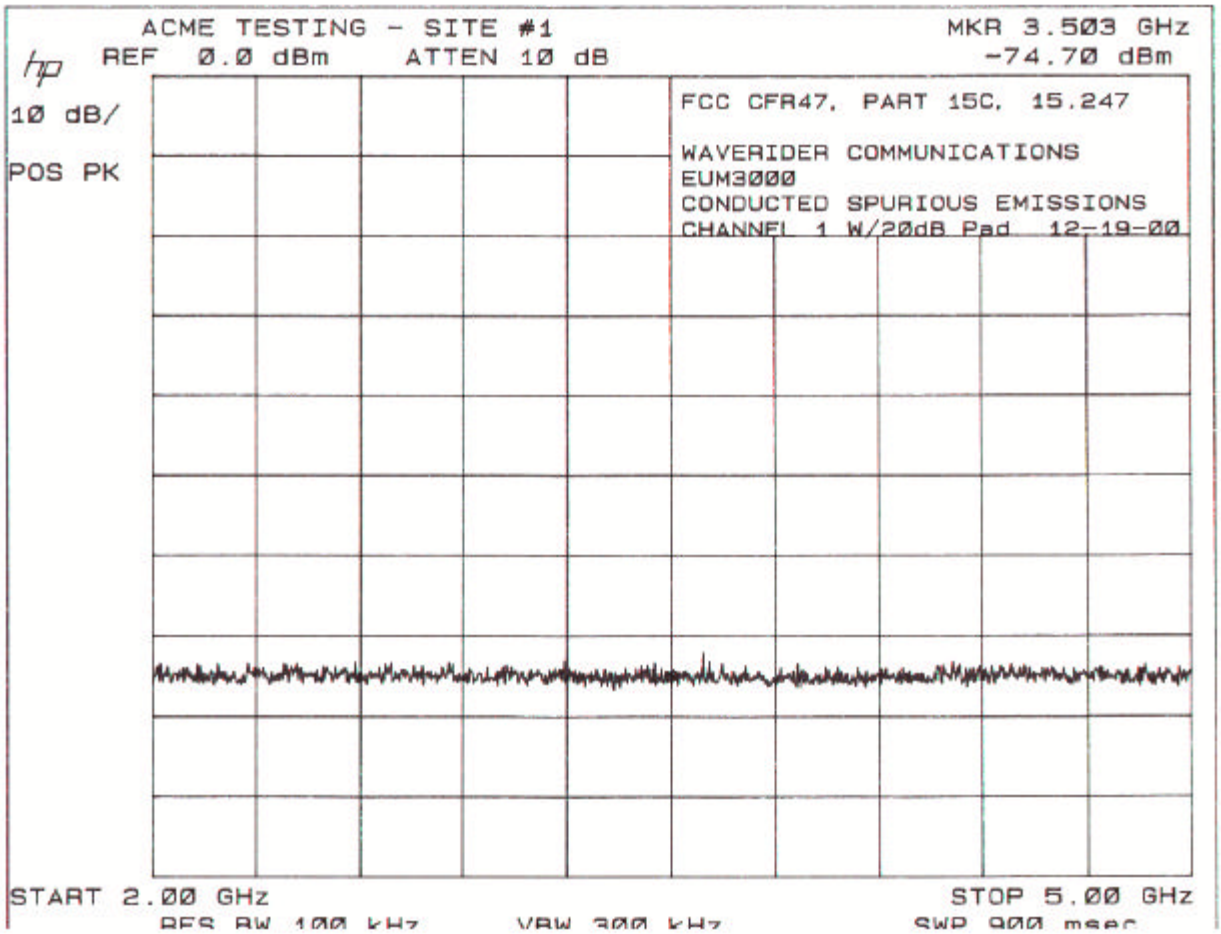
The RF output of the EUT is connected to the RF input port of the RF preselector. The following measurements were made with a RBW = 100 kHz and VBW = 300 kHz.

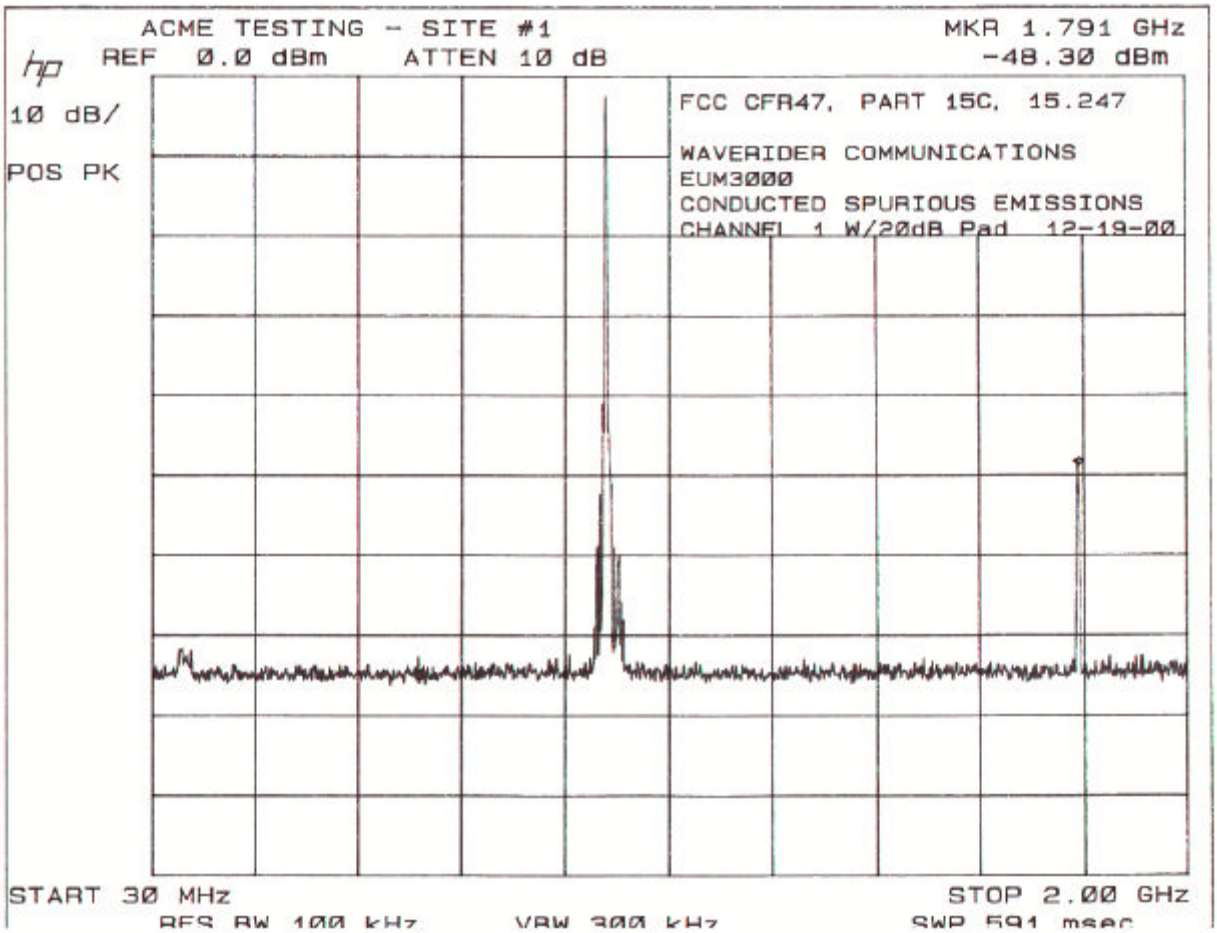
10.4 Test Results

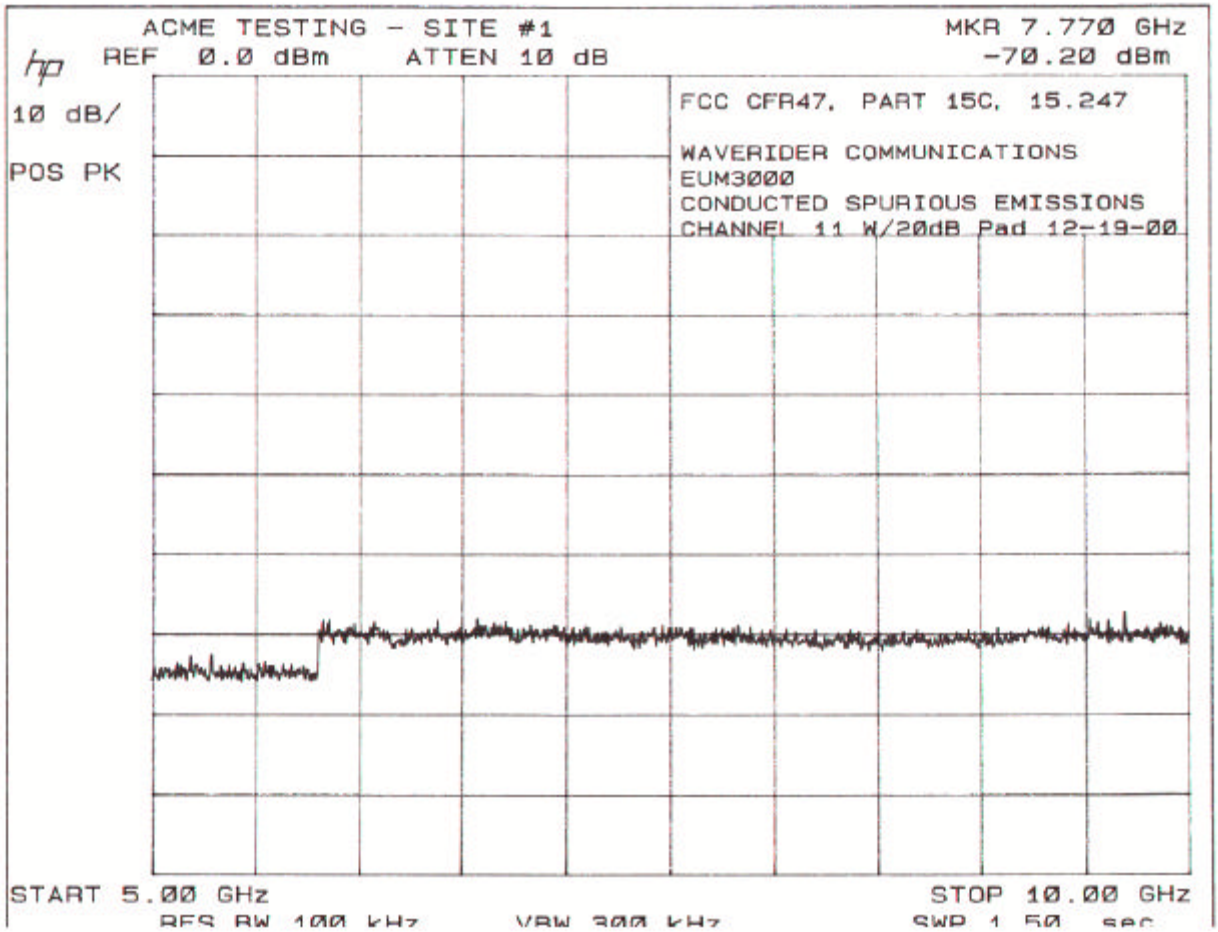
No out of band conducted emissions were detected within 35 dB of the carrier power.

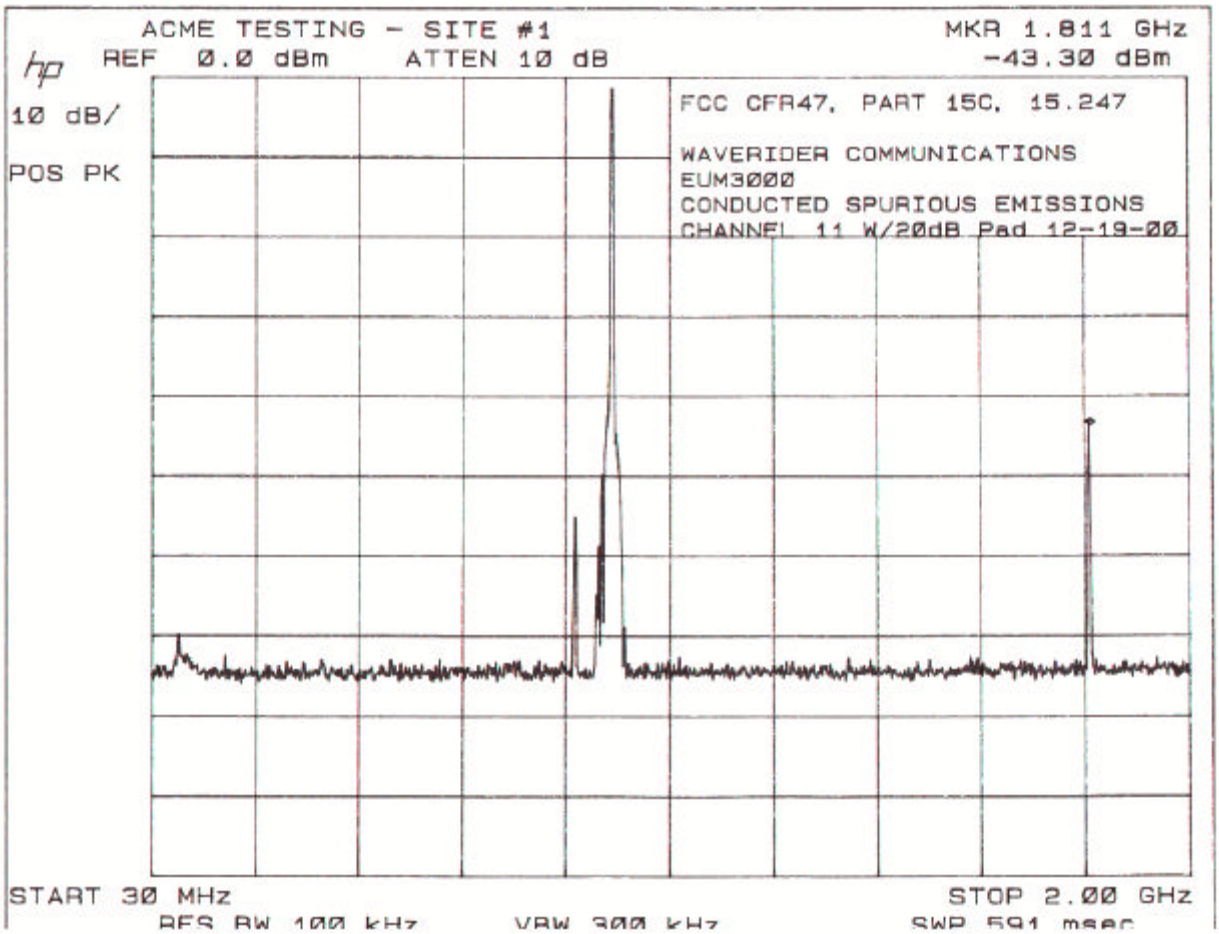
10.5 Graphical Data

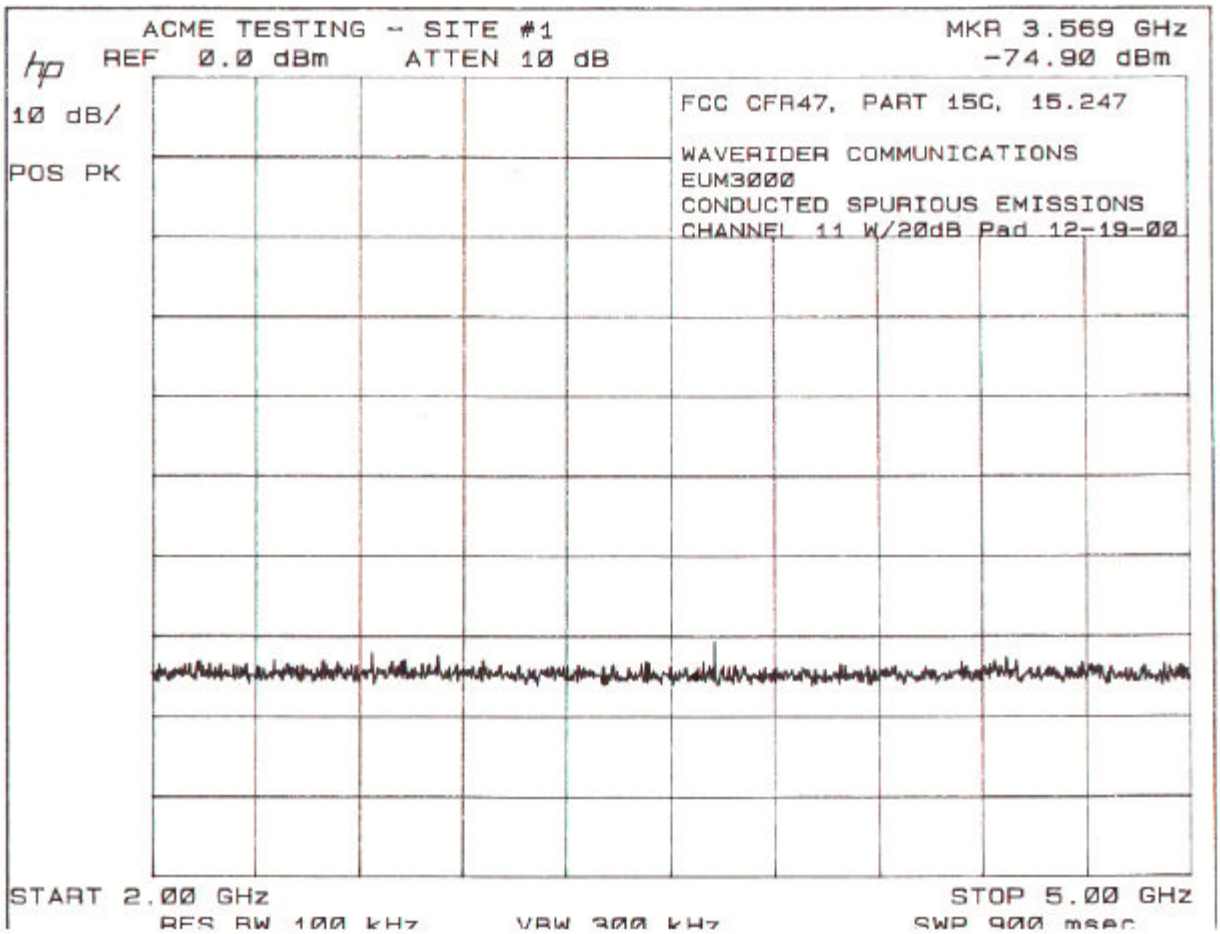


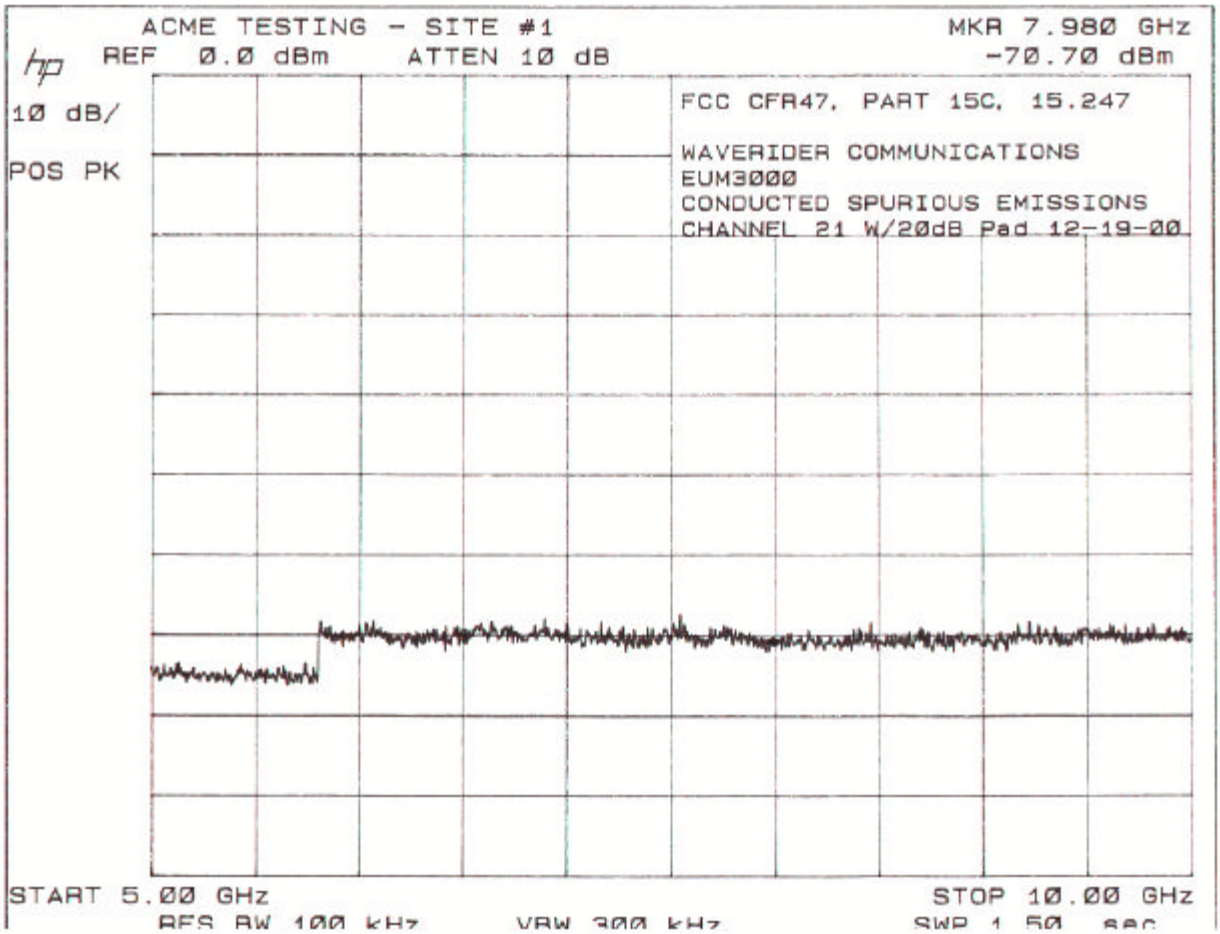

ACME TESTING - SITE #1
MKR 3.503 GHz
REF 0.0 dBm
ATTEN 10 dB
-74.70 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
CONDUCTED SPURIOUS EMISSIONS
CHANNEL 1 W/20dB Pad 12-19-00
START 2.00 GHz
STOP 5.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 900 msec

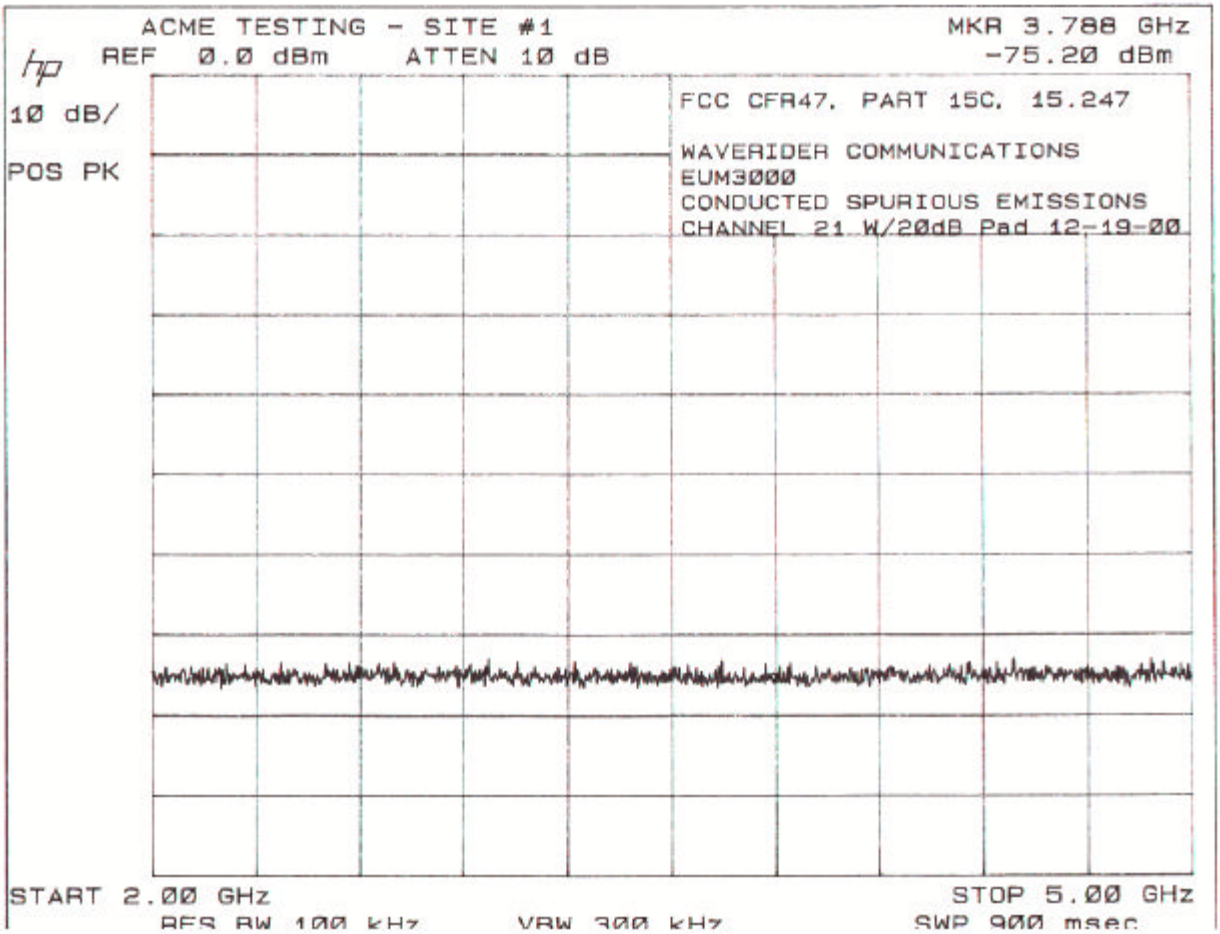

ACME TESTING - SITE #1
MKR 1.791 GHz
REF 0.0 dBm
ATTEN 10 dB
-48.30 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
CONDUCTED SPURIOUS EMISSIONS
CHANNEL 1 W/20dB Pad 12-19-00
START 30 MHz
STOP 2.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 591 msec

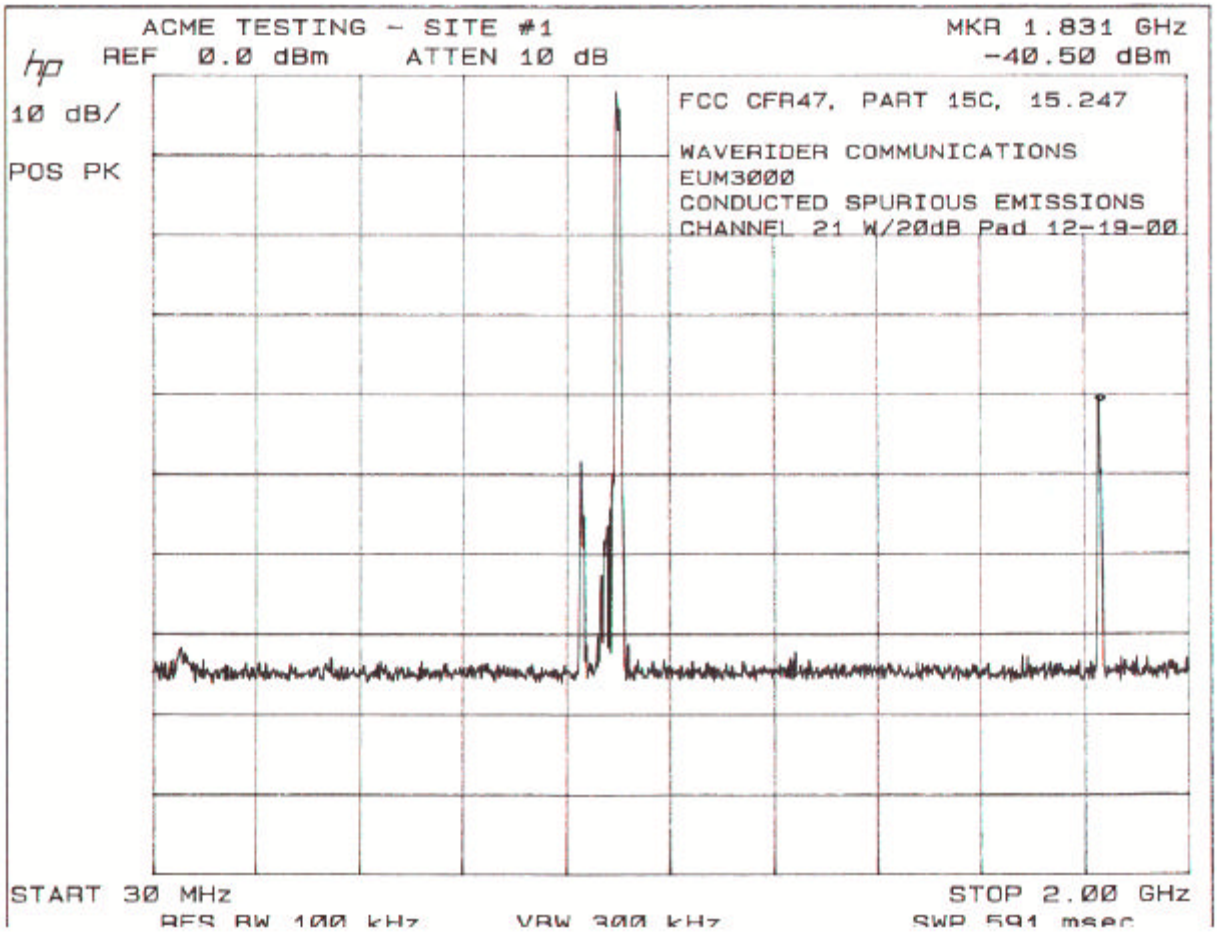

ACME TESTING - SITE #1
MKR 7.770 GHz
REF 0.0 dBm
ATTEN 10 dB
-70.20 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
CONDUCTED SPURIOUS EMISSIONS
CHANNEL 11 W/20dB Pad 12-19-00
START 5.00 GHz
STOP 10.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 1.50 sec


ACME TESTING - SITE #1
MKR 1.811 GHz
REF 0.0 dBm
ATTEN 10 dB
-43.30 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
CONDUCTED SPURIOUS EMISSIONS
CHANNEL 11 W/20dB Pad 12-19-00
START 30 MHz
STOP 2.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 591 msec


ACME TESTING - SITE #1
MKR 3.569 GHz
REF 0.0 dBm
ATTEN 10 dB
-74.90 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
CONDUCTED SPURIOUS EMISSIONS
CHANNEL 11 W/20dB Pad 12-19-00
START 2.00 GHz
STOP 5.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 900 msec


ACME TESTING - SITE #1
MKR 7.980 GHz
REF 0.0 dBm
ATTEN 10 dB
-70.70 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
CONDUCTED SPURIOUS EMISSIONS
CHANNEL 21 W/20dB Pad 12-19-00
START 5.00 GHz
STOP 10.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 1.50 sec


ACME TESTING - SITE #1
MKR 3.788 GHz
REF 0.0 dBm
ATTEN 10 dB
-75.20 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
CONDUCTED SPURIOUS EMISSIONS
CHANNEL 21 W/20dB Pad 12-19-00
START 2.00 GHz
STOP 5.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 900 msec


ACME TESTING - SITE #1
MKR 1.831 GHz
REF 0.0 dBm
ATTEN 10 dB
-40.50 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
CONDUCTED SPURIOUS EMISSIONS
CHANNEL 21 W/20dB Pad 12-19-00
START 30 MHz
STOP 2.00 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 591 msec

11. Radiated Spurious Emissions

11.1 Regulation

15.247 I In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

11.2 Test Equipment

⇒ Spectrum Analyzer (yellow): Hewlett-Packard 8566B, Serial Number 2403A06519, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ Quasi Peak Adapter (yellow): Hewlett-Packard 85650A, Serial Number 2521A-00689, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ Line Impedance Stabilization Network: EMCO 3825/2, Serial Number 9002-1601, Calibrated: 2 January 2000, Calibration due Date: 2 January 2001

⇒ Broadband Biconical Antenna (red) (20 MHz to 200 MHz): EMCO 3110, Serial Number 1115, Calibrated: 26 December 2000, Calibration due Date: 26 December 2001

⇒ Broadband Log Periodic Antenna (red) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 2853, 26 December 2000, Calibration due Date: 26 December 2001

⇒ EUT Turntable Position Controller: Rothenbuhler Engineering, Custom, No Calibration Required

⇒ Antenna Mast: Compliance Design, model M100/200, No Calibration Required

⇒ Pyramidal Horn Antenna: EMCO 3160-10, Serial Number 9708-1055, Calibration Not Required

⇒ 2 GHz to 10 GHz Low Noise Preamplifier: Milliwave 593-2898, Serial Number 2494, Calibrated: 5 May 2000, Calibration Due Date: 5 May 2001

⇒ Double Ridge Guide Horn Antenna: EMCO 3115, Serial Number 9807-5534, Calibrated: 30 December 2000, Calibration due Date: 30 December 2001

⇒ 8 – 22GHz Preamplifier: MITEQ AFS4-35LN, Serial Number 484280, Calibrated: 3 January 2000, Calibration Due Date: 3 January 2001

11.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that sits on a flush mounted metal turntable. Floor standing equipment is placed directly on the flush mounted metal turntable. The EUT is connected to its associated peripherals with any excess I/O cabling bundled to approximately 1 meter.

Preview tests are performed to determine the "worst case" mode of operation. With the EUT operating in "worst case" mode, emissions from the unit are maximized by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz – 10000 MHz **15.205 RESTRICTED BANDS ONLY**
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz (30 MHz – 1000 MHz) 1 MHz (1000 MHz – 10,000 MHz)
Receive antenna scan height	1 m – 4 m
Receive antenna polarization	Vertical/Horizontal

11.4 Test Results

With YAGI Antenna

Emission Number	Frequency (MHz)	EUT Emission (dBuV/m)	Spec limit (dBuV/m)	Delta to the limit dB	Detector Function (Peak, Quasi-Peak)	Polarity (Vertical/ Horizontal)	Antenna Height (cm)	Table Azimuth (deg.)	Comments
1	2714.70	42.1	74	-31.9	PK	V	100	350	CHANNEL 1
2	2714.88	44.1	74	-29.9	PK	H	200	120	CHANNEL 1
3	2715.22	31.9	54	-21.1	AVG	V	100	350	CHANNEL 1
4	2715.52	34.9	54	-19.1	AVG	H	200	120	CHANNEL 1
5	3619.88	46.4	74	-27.6	PK	V	230	10	CHANNEL 1
6	3619.86	48.9	74	-25.1	PK	H	220	10	CHANNEL 1
7	3619.94	38.5	54	-15.5	AVG	V	230	10	CHANNEL 1
8	3619.94	43.0	54	-11.0	AVG	H	220	10	CHANNEL 1
9	4524.74	41.2	74	-32.8	PK	V	100	10	CHANNEL 1
10	4524.78	42.7	74	-31.3	PK	H	200	120	CHANNEL 1
11	4525.02	33.7	54	-20.3	AVG	V	100	10	CHANNEL 1
12	4524.84	33.5	54	-20.5	AVG	H	200	120	CHANNEL 1
13	2744.78	56.5	74	-17.5	PK	V	220	0	CHANNEL 11
14	2744.84	49.8	74	-24.2	PK	H	110	20	CHANNEL 11
15	2745.82	47.2	54	-6.8	AVG	V	220	0	CHANNEL 11
16	2745.76	40.2	54	-13.8	AVG	H	110	20	CHANNEL 11
17	3659.80	54.6	74	-19.4	PK	V	170	100	CHANNEL 11
18	3659.82	54.1	74	-19.9	PK	H	150	50	CHANNEL 11
19	3659.86	47.8	54	-6.2	AVG	V	170	100	CHANNEL 11
20	4575.90	49.3	74	-24.7	PK	H	150	90	CHANNEL 11
21	4574.68	47.1	74	-26.9	PK	V	160	90	CHANNEL 11
22	4574.94	37.6	54	-16.4	AVG	H	150	90	CHANNEL 11
23	4575.08	35.2	54	-18.8	AVG	V	160	90	CHANNEL 11
24	2774.84	58.4	74	-15.6	PK	V	130	65	CHANNEL 21
25	2774.82	54.1	74	-19.9	PK	H	165	45	CHANNEL 21
26	2775.96	49.8	54	-4.2	AVG	V	130	65	CHANNEL 21
27	2775.86	43.6	54	-10.4	AVG	H	165	45	CHANNEL 21
28	3699.84	61.8	74	-12.2	PK	V	130	75	CHANNEL 21
29	3699.84	59.6	74	-14.4	PK	H	215	15	CHANNEL 21
30	3699.86	50.8	54	-3.2	AVG	V	130	75	CHANNEL 21
31	3699.88	51.2	54	-2.8	AVG	H	215	15	CHANNEL 21
32	4624.70	47.4	74	-26.6	PK	V	155	55	CHANNEL 21
33	4624.70	47.7	74	-26.3	PK	H	155	110	CHANNEL 21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With PATCH Antenna

Emission Number	Frequency (MHz)	EUT Emission (dBuV/m)	Spec limit (dBuV/m)	Delta to the limit dB	Detector Function (Peak, Quasi-Peak)	Polarity (Vertical/ Horizontal)	Antenna Height (cm)	Table Azimuth (deg.)	Comments
1	2659.8	55.3	74	-18.7	PK	H	170	70	CHANNEL 11
2	2714.74	44.5	74	-29.5	PK	H	215	190	CHANNEL 1
3	2714.82	44.3	74	-29.7	PK	V	100	190	CHANNEL 1
4	2744.82	49.2	74	-24.8	PK	H	160	140	CHANNEL 11
5	2744.9	47.6	74	-26.4	PK	V	150	20	CHANNEL 11
6	2774.86	48.8	74	-25.2	PK	V	120	145	CHANNEL 21
7	2774.88	53.3	74	-20.7	PK	H	190	150	CHANNEL 21
8	2775.94	45.5	54	-8.5	AVG	H	190	150	CHANNEL 21
9	3619.74	54.4	74	-19.6	PK	H	170	359	CHANNEL 1
10	3619.82	54	74	-20	PK	V	115	0	CHANNEL 1
11	3619.87	45.7	54	-8.3	AVG	H	170	359	CHANNEL 1
12	3619.95	46.9	54	-7.1	AVG	V	115	0	CHANNEL 1
13	3659.8	54.4	74	-19.6	PK	V	150	2	CHANNEL 11


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With OMNI DIRECTIONAL Antenna

Emission Number	Frequency (MHz	EUT Emission (dBuV/m)	Spec Limit (dBuV/m)	Delta to the limit dB	Detector Function (Peak, Quasi-Peak)	Polarity (Vertical/ Horizontal)	Antenna Height (cm)	Table Azimuth (deg.)	Comments
1	2714.96	42.9	74	-31.1	PK	V	145	20	CHANNEL 1
2	2714.98	45.7	74	-28.3	PK	H	195	150	CHANNEL 1
3	2744.86	47.9	74	-26.1	PK	V	100	160	CHANNEL 11
4	2745.00	47.7	74	-26.3	PK	H	175	145	CHANNEL 11
5	2774.64	49.6	74	-24.4	PK	V	270	170	CHANNEL 21
6	2774.86	50.9	74	-23.1	PK	H	185	145	CHANNEL 21
7	3619.68	49.2	74	-24.8	PK	V	180	359	CHANNEL 1
8	3619.94	50.6	74	-23.4	PK	H	200	70	CHANNEL 1
9	3659.82	54.6	74	-19.4	PK	V	145	0	CHANNEL 11
10	3659.82	58.7	74	-15.3	PK	H	195	90	CHANNEL 11
11	3659.84	50.6	54	-3.4	AVG	H	195	90	CHANNEL 11
12	3659.96	49.9	54	-4.1	AVG	V	145	0	CHANNEL 11
13	3699.76	60.3	74	-13.7	PK	V	115	180	CHANNEL 21
14	3699.76	61.8	74	-12.2	PK	H	200	100	CHANNEL 21
15	3699.86	50.7	54	-3.3	AVG	V	115	180	CHANNEL 21
16	3700.00	52.0	54	-2.0	AVG	H	200	100	CHANNEL 21
17	4524.96	43.7	74	-30.3	PK	H	155	60	CHANNEL 1
18	4525.02	41.8	74	-32.2	PK	V	100	359	CHANNEL 1
19	4574.56	46.1	74	-27.9	PK	V	120	0	CHANNEL 11
20	4574.94	48.6	74	-25.4	PK	H	155	110	CHANNEL 11
21	4624.66	49.0	74	-25.0	PK	H	200	180	CHANNEL 21
22	4625.26	46.2	74	-27.8	PK	V	130	355	CHANNEL 21


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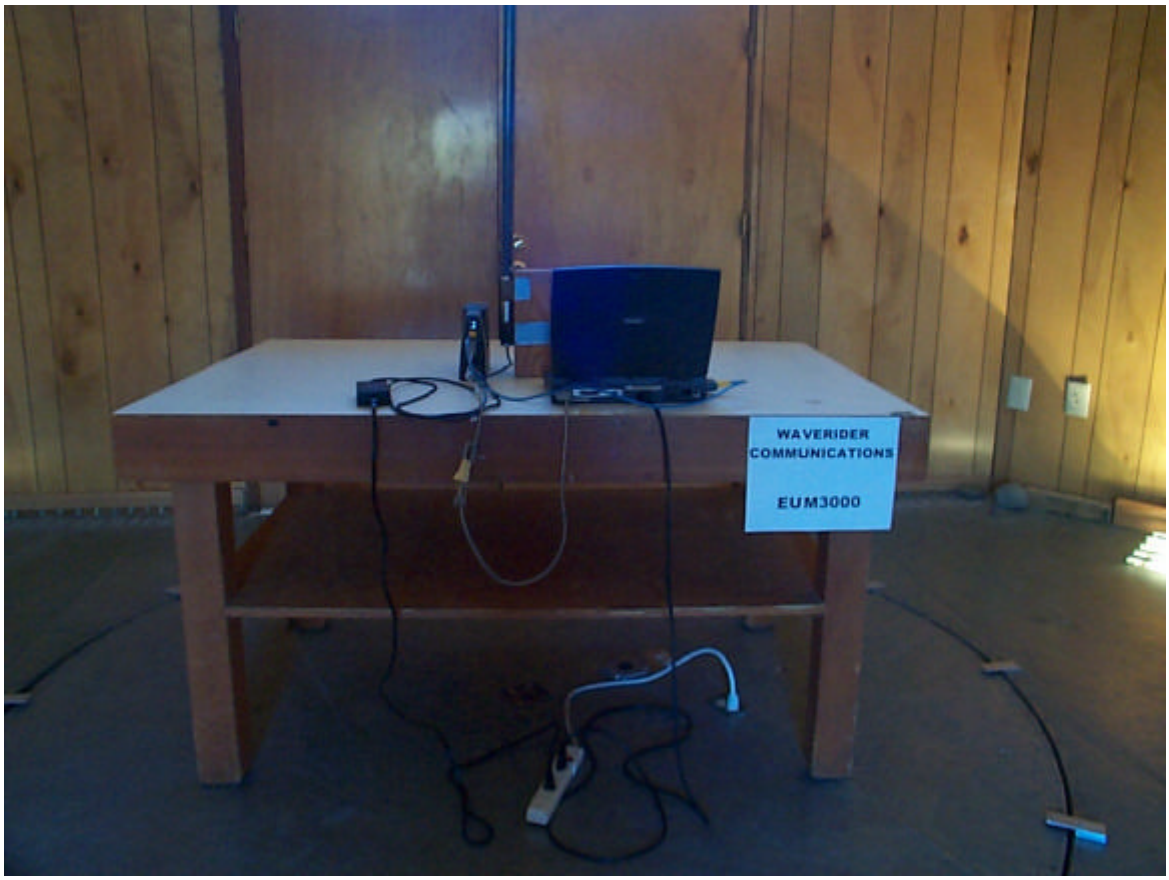
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With DISK Antenna

Emission Number	Frequency (MHz	EUT Emission (dBuV/m)	Spec Limit (dBuV/m)	Delta to the limit dB	Detector Function (Peak, Quasi-Peak)	Polarity (Vertical/ Horizontal)	Antenna Height (cm)	Table Azimuth (deg.)	Comments
1	2714.88	43.6	74	-30.4	PK	V	115	90	CHANNEL 1
2	2714.96	44.7	74	-29.3	PK	H	160	80	CHANNEL 1
3	2744.78	48.7	74	-25.3	PK	H	210	100	CHANNEL 11
4	2745.08	43.9	74	-30.1	PK	V	105	300	CHANNEL 11
5	2774.80	53.3	74	-20.7	PK	V	110	75	CHANNEL 21
6	2774.82	53.8	74	-20.2	AVG	H	185	25	CHANNEL 21
7	2775.80	44.1	54	-9.9	AVG	V	110	75	CHANNEL 21
8	2775.90	42.6	54	-11.4	PK	H	185	25	CHANNEL 21
9	3619.88	54.9	74	-19.1	PK	V	105	90	CHANNEL 1
10	3619.88	53.6	74	-20.4	PK	H	215	10	CHANNEL 1
11	3619.94	44.4	54	-9.6	AVG	V	105	90	CHANNEL 1
12	3620.02	44.7	54	-9.3	AVG	H	215	10	CHANNEL 1
13	3659.72	56.8	74	-17.2	PK	H	210	10	CHANNEL 11
14	3659.80	56.2	74	-17.8	PK	V	105	85	CHANNEL 11
15	3659.90	48.7	54	-5.3	AVG	V	105	85	CHANNEL 11
16	3659.94	49.0	54	-5.0	AVG	H	210	10	CHANNEL 11
17	3699.82	62.2	74	-11.8	PK	V	100	80	CHANNEL 21
18	3699.86	59.3	74	-14.7	AVG	H	200	10	CHANNEL 21
19	3700.00	52.6	54	-1.4	AVG	V	100	80	CHANNEL 21
20	3700.00	50.0	54	-4.0	PK	H	200	10	CHANNEL 21
21	4524.38	42.2	74	-31.8	PK	H	160	30	CHANNEL 1
22	4524.98	42.2	74	-31.8	PK	V	100	150	CHANNEL 1
23	4574.86	50.2	74	-23.8	PK	H	165	90	CHANNEL 11
24	4574.88	47.2	74	-26.8	PK	V	105	90	CHANNEL 11
25	4624.82	47.3	74	-26.7	PK	V	130	40	CHANNEL 21
26	4624.96	48.5	74	-25.5	AVG	H	185	150	CHANNEL 21


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With DIPOLE Antenna

Emission Number	Frequency (MHz	EUT Emission (dBuV/m)	Spec Limit (dBuV/m)	Delta to the limit dB	Detector Function (Peak, Quasi-Peak)	Polarity (Vertical/ Horizontal)	Antenna Height (cm)	Table Azimuth (deg.)	Comments
1	2714.84	44.3	74	-29.7	PK	V	120	90	CHANNEL 1
2	2714.84	46.6	74	-27.4	PK	H	200	120	CHANNEL 1
3	2744.88	50.0	74	-24.0	PK	H	130	170	CHANNEL 11
4	2745.00	48.0	74	-26.0	PK	V	120	90	CHANNEL 11
5	2774.92	52.7	74	-21.3	PK	H	190	120	CHANNEL 21
6	2774.96	49.8	74	-24.2	PK	V	120	120	CHANNEL 21
7	2775.74	43.1	54	-10.9	AVG	H	190	120	CHANNEL 21
8	3619.64	51.6	74	-22.4	PK	H	180	180	CHANNEL 1
9	3619.84	54.5	74	-19.5	PK	V	110	85	CHANNEL 1
10	3619.94	45.3	54	-8.7	AVG	V	110	85	CHANNEL 1
11	3619.98	42.5	54	-11.5	AVG	H	180	180	CHANNEL 1
12	3659.80	56.6	74	-17.4	PK	V	110	80	CHANNEL 11
13	3659.80	59.7	74	-14.3	PK	H	195	180	CHANNEL 11
14	3659.82	51.5	54	-2.5	AVG	H	195	180	CHANNEL 11
15	3659.84	48.8	54	-5.2	AVG	V	110	80	CHANNEL 11
16	3699.82	61.9	74	-12.1	PK	H	195	190	CHANNEL 21
17	3699.84	62.1	74	-11.9	PK	V	105	80	CHANNEL 21
18	3699.94	52.2	54	-1.8	AVG	V	105	80	CHANNEL 21
19	3699.96	52.3	54	-1.7	AVG	H	195	190	CHANNEL 21
20	4524.80	42.7	74	-31.3	PK	V	120	190	CHANNEL 1
21	4524.94	43.2	74	-30.8	PK	H	200	200	CHANNEL 1
22	4574.54	48.5	74	-25.5	AVG	H	195	150	CHANNEL 11
23	4574.88	47.4	74	-26.6	PK	V	150	140	CHANNEL 11
24	4624.74	46.7	74	-27.3	PK	V	115	70	CHANNEL 21
25	4624.90	49.7	74	-24.3	PK	H	135	175	CHANNEL 21
26	2714.84	44.3	74	-29.7	PK	V	120	90	CHANNEL 1


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12. Peak Power Spectral Density

12.1 Regulation

For direct sequence systems, the peak 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.

12.2 Test Equipment

⇒ Spectrum Analyzer (yellow): Hewlett-Packard 8566B, Serial Number 2403A06519, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

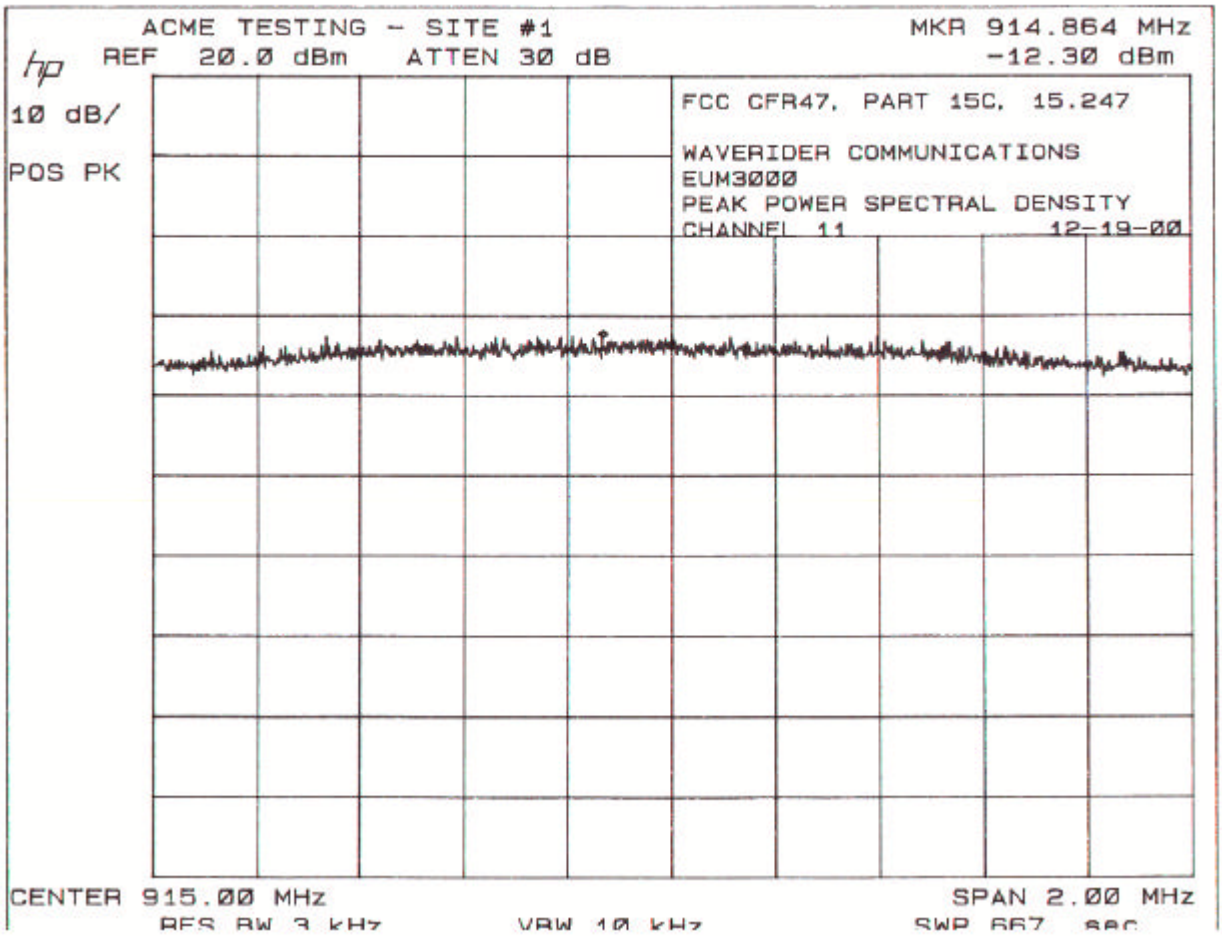
12.3 Test Procedures

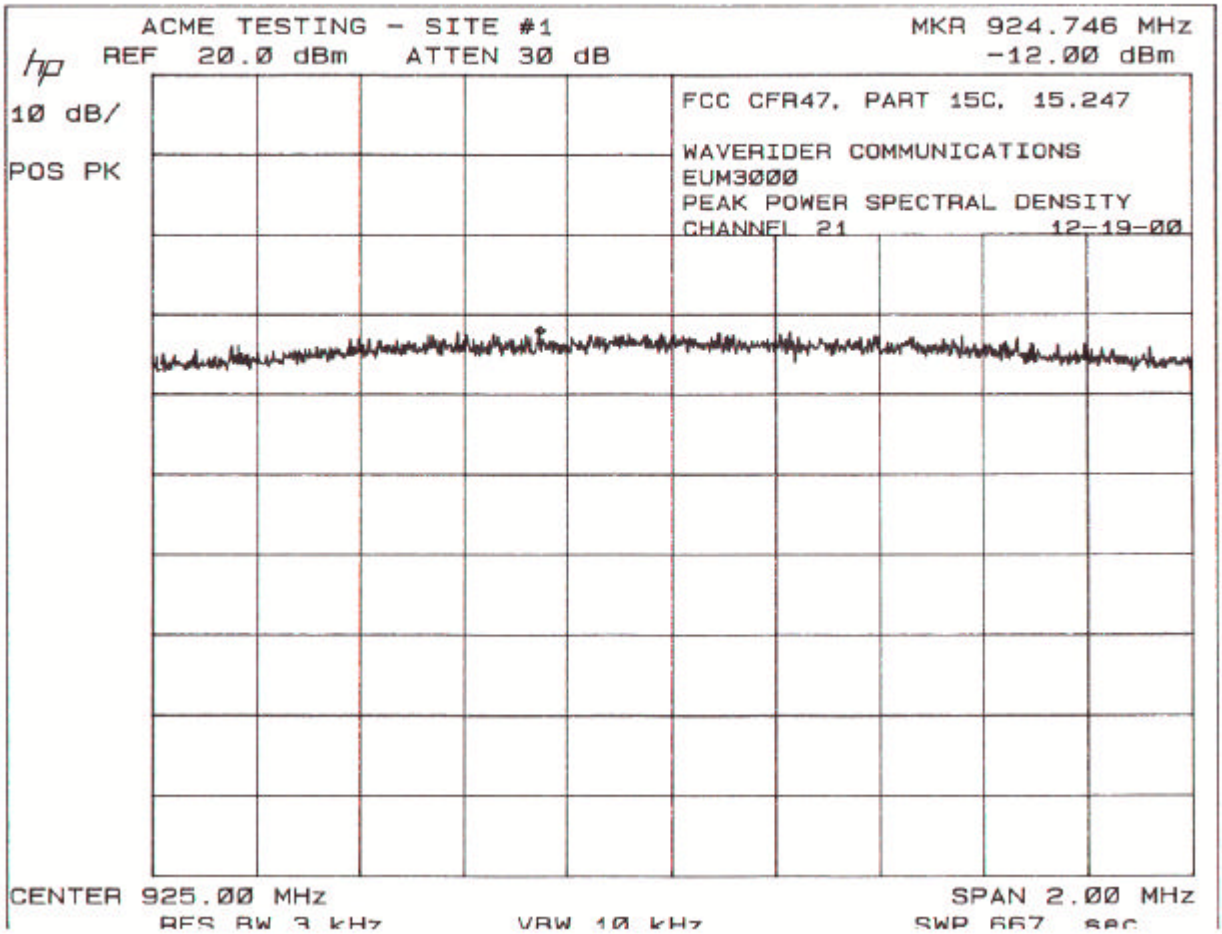
The RF output of the EUT is connected to the RF input port of the RF preselector through a 20 dB pad. The following measurements were made with a RBW = 3 kHz, VBW = 10 kHz and Sweep Time = 667 seconds.

12.4 Test Results

Maximum peak power spectral density of channel 1 is 7.8 dBm.
Maximum peak power spectral density of channel 11 is 7.7 dBm.
Maximum peak power spectral density of channel 21 is 8 dBm.

12.5 Graphical Data




ACME TESTING - SITE #1
MKR 924.746 MHz
REF 20.0 dBm
ATTEN 30 dB
-12.00 dBm
10 dB/
POS PK
FCC CFR47, PART 15C, 15.247
WAVERIDER COMMUNICATIONS
EUM3000
PEAK POWER SPECTRAL DENSITY
CHANNEL 21
12-19-00
CENTER 925.00 MHz
SPAN 2.00 MHz
RES BW 3 kHz
VBW 10 kHz
SWP 667 sec

13. Process gain requirements

13.1 Regulation

The processing gain of a direct sequence system shall be at least 10 dB. The processing gain represents the improvement to the received signal-to-noise ratio, after filtering to the information bandwidth, from the spreading/despreading function. The processing gain may be determined using one of the following methods:

(1) As measured at the demodulated output of the receiver: the ratio in dB of the signal-to-noise ratio with the system spreading code turned off to the signal-to-noise ratio with the system spreading code turned on.

(2) As measured using the CW jamming margin method: a signal generator is stepped in 50 kHz increments across the passband of the system, recording at each point the generator level required to produce the recommended Bit Error Rate (BER). This level is the jammer level. The output power of the intentional radiator is measured at the same point. The jammer to signal ratio (J/S) is then calculated, discarding the worst 20% of the J/S data points. The lowest remaining J/S ratio is used to calculate the processing gain as follows: Gp = (S/N)o + Mj + Lsys, where Gp = processing gain of the system, (S/N)o = signal-to-noise ratio required for the chosen BER, Mj = J/S ratio, and Lsys = system losses. Note that total losses in a system, including intentional radiator and receiver, should be assumed to be no more than 2 dB.

13.2 Result

Please see the process gain measurements in the attachments. The process gain of the product exceeds 10 dB.

14. Labeling Information

Location

ALL PHOTOS REMOVED TO SEPARATE EXHIBITS – TCB.

Text

15. EUT Photos

CHASSIS FRONT VIEW

CHASSIS REAR VIEW

SIDE VIEW - 1

SIDE VIEW -2

PCB TOP VIEW WITH SHIELDS

PCB TOP VIEW – PARTIAL SHIELDS

PCB TOP VIEW – WITHOUT SHIELDS

PCB BOTTOM VIEW – WITH SHIELDS

PCB BOTTOM VIEW – WITHOUT SHIELDS

16. Miscellaneous Comments and Notes

1. None.