2002 Valley Highway PO Box 3 Acme WA 98220-0003
phone:888 226-3837 fax: 360 595-2722

REPORT OF MEASUREMENTS
PART 15C (15.247) – INTENTIONAL RADIATOR

DEVICE: WIRELESS MODEM

MODEL: ESTeem 192E

MANUFACTURER: ELECTRONIC SYSTEMS TECHNOLOGY, INC.

ADDRESS: 415 N. QUAY STREET
KENNEWICK WA 99336

WORK ORDER: 01-EMC-042503

1. General

1.1 Document History

REVISION	DATE	COMMENTS
-	25 May 2001	Initial Release, Harry H. Hodes
A	6 July 2001	Additional Test Results added to include all antenna's applicable for application for grant by FCC/TCB. Formatting changes per additional engineering review, Andrew Pace & Harry H. Hodes
B	26 July 2001	Additional information as required per TCB review.
C	06 August 2001	Additional information as required per TCB review.
D	02 October 2001	Additional Information as required per FCC review

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 on 29 April 2001. Testing was performed on the units described in this report on 29 April & 03 May 2001.
- 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 present data that demonstrates compliance of the Electronic Systems Technology, Inc. Model ESTeem 192E Wireless Modem to the FCC regulations for Direct Sequence Spread Spectrum unlicensed devices operating under Section 15.247 of 47CFR Part 15 Subpart C.

1.3 Manufacturer

Company Name:	Electronic Systems Technology, Inc
Contact:	Brent Strecker
Street Address:	415 N. Quay Street
City/State/Zip:	Kennewick WA 99336
Telephone:	509 735-9092
Fax:	509 783-5475
Web:	www.esteem.com

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 Accreditations and Listings

Acme Testing Co.'s test facilities are accredited by A2LA for a specific scope of accreditation which includes the tests detailed herein, 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, Acme Testing Co.'s test facilities are also registered with the Industry Canada under registration numbers: IC3251 (Acme, WA), and IC3618 (Plummer, ID).

2. Test Results Summary

Summary of Test Results
Wireless Modem, Model ESTeem 192E

Requirement	CFR Section	Test Result
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
Conducted Spurious < -20 dBc	15.247(c)	PASS
Radiated Spurs (less than limits shown in section 15.209)	15.205(b), 15.31(e)	PASS
Power Density < 8dBm in 3 kHz	15.247(d)	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'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 assumes responsibility only for the accuracy and completeness of this data as it pertains to the sample tested.

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

Daniel B. Stotler for Andrew Pace — 10/2/01

Andrew Pace — Daniel B. Stotler — Date of Issuance
EMC Engineer — Laboratory Operations Manager

REVIEWED AND APPROVED BY:

2 OCTOBER 2001

Harry H. Hodes — Date of Issuance
President/CEO
Principal EMC Engineer

3. Description of Equipment

3.1 Equipment Under Test (EUT)

Device: Wireless Modem: consists of
a) "Brick" Power Supply (120 VAC/60 Hz input 12 VDC output)
b) Wireless modem unit (Model ESTeem 192E)
c) Antenna (any one of the following 3 antennas)
1. Model AA01S (2 dBd Omnidirectional "Rubber Duckie")
2. Model AA20S (5 dBd Omnidirectional, Indoor configuration)
3. Model AA202S (13.9 dBd Directional, Outdoor configuration)

Model Number: ESTeem 192E
Serial Number: 12002
FCC ID: None
Power: 120 V/60 Hz
Grounding: 3-Wire AC Plug
Size of EUT: 26 cm x 24 cm x 8.3 cm

Note: The EUT is a 2.4 GHz Band Low Power (unlicensed) Transceiver that is used as a wireless LAN modem.

3.2 The Mode of Operation During Tests

The transceiver was operated in a test configuration. That is, a laptop computer containing test code was serially connected to the EUT. Depending on the characteristic being tested, the following setting were modified in software:

1. The transceiver could be set to one of three channels in the operating range of 2.4 to 2.4835 MHz
2. Modulation could be turned on or off

With those settings in place, the laptop was then used to turn on the transceiver with whatever setting-changes that had been made. If modulation was turned on, the laptop was used to transmit packet data to the EUT serially. This packet data was then transmitted by the EUT in the form of a direct sequence spread spectrum signal on the chosen channel.

3.3 Modifications Required for Emissions Compliance

None.

3.4 Support Equipment Used During Testing

Device	Manufacturer	Model Number	FCC ID	Serial Number
Lightning Protection	PSX	AA164	None	None

3.5 Description of Cables for Emissions

EUT/Antenna AA20S (RG-8)

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	7.62 m	No

EUT/Antenna AA202S (Heliax)

Shielded	Unshielded	Flat	Round	Length	Ferrite
Yes	No	No	Yes	15.2 m	No

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

3.6 EUT Photographs

4. Antenna requirement

4.1 Regulation

47CFR Part 15 Subpart C Section 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.

4.2 Test Results

The ESTeem 192E incorporates a reverse-polarity TNC antenna connector to comply with this requirement.

5. AC Power Line Conducted Emissions Tests

Test Requirement: 47CFR Part 15 Subpart C Section 15.247

Test Procedure: ANSI C63.4:1992

Date of Test: 29 April 2001

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 Conduction Test Site: Acme Testing Co., Test Site Number 1, Calibrated: 1 December 2000, Calibration due Date: 1 December 2001

⇒ Line Impedance Stabilization Network: EMCO 3825/2, Serial Number 9002-1601, Calibrated: 2 January 2001, Calibration due Date: 2 January 2002

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

The EUT was placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that was placed above the groundplane. The EUT was connected to its power supply and antenna. The EUT's power supply was connected to a dedicated LISN, that was bonded to the groundplane.

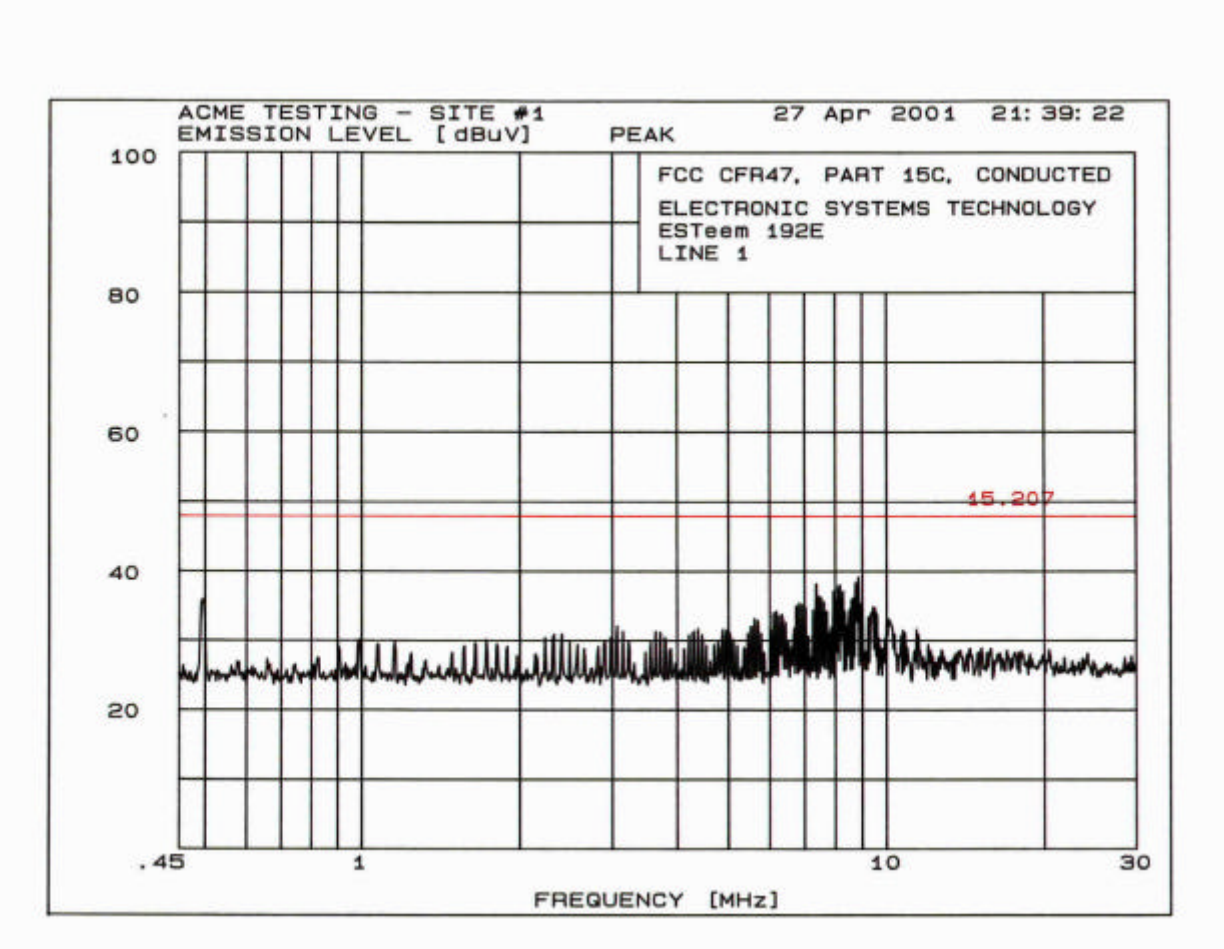
Preview tests were performed to determine the "worst case" mode of operation. With the EUT operating in "worst case" mode, final conducted measurements were taken. Conducted measurements were made on each current carrying conductor with respect to ground.

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

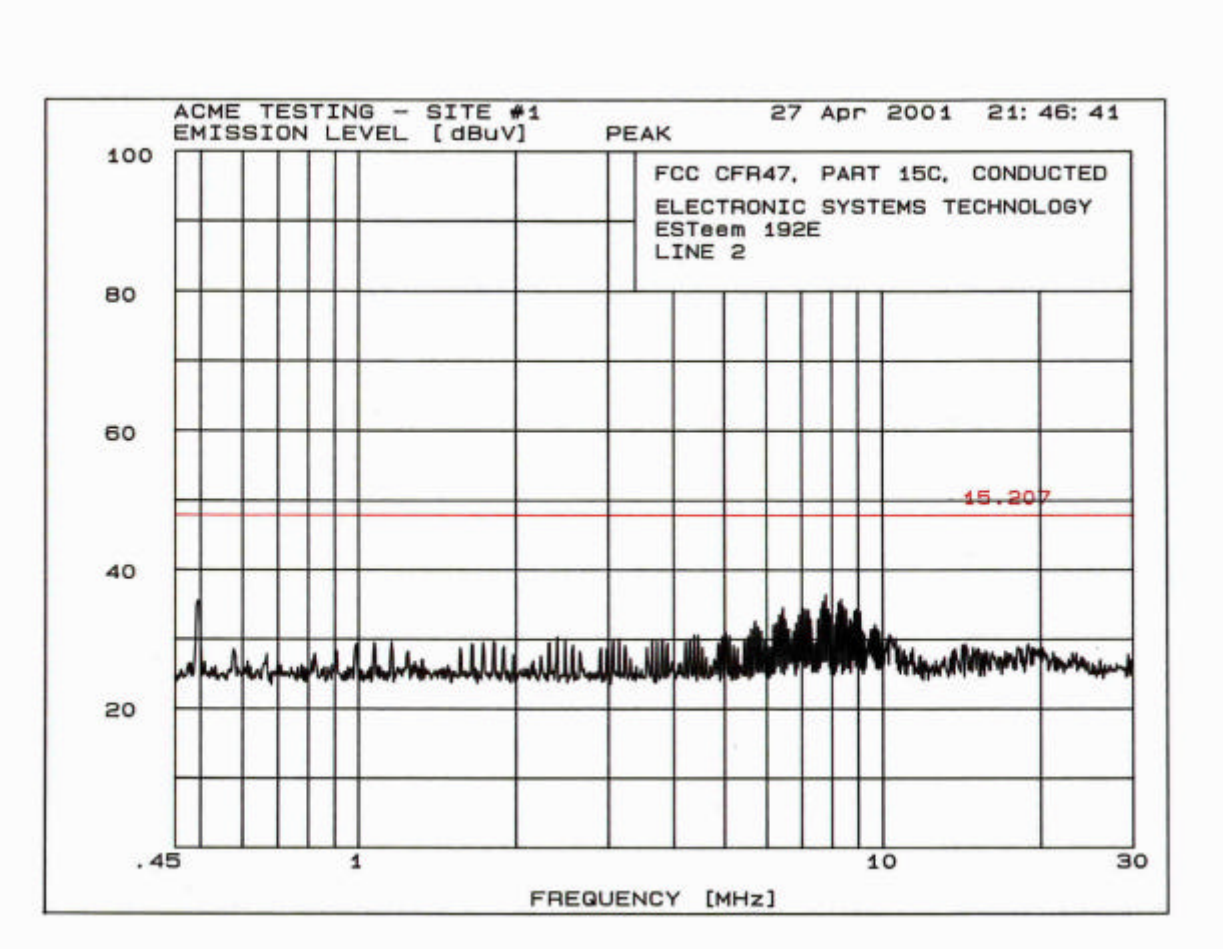
FCC RULES 47CFR PART 15C, SUBPART 15.247,CLASS B
CONDUCTED EMISSIONS (0.45 MHZ TO 30 MHZ) 60 Hz/120 VAC
LINE 1

PEAK #	FREQ. (MHz)	AMPL (dBµV)
1	7.357	38.2
2	7.935	37.1
3	8.103	37.8
4	8.171	38.0
5	8.274	37.1
6	8.849	39.1



FCC RULES 47CFR PART 15C, SUBPART 15.247,CLASS B
CONDUCTED EMISSIONS (0.45 MHZ TO 30 MHZ) 60 Hz/120 VAC
LINE 2

PEAK #	FREQ. (MHz)	AMPL (dBµV)
1	0.4956	35.5
2	6.996	34.7
3	7.673	35.4
4	7.77	36.4
5	8.24	35.3
6	8.344	35.7
7	8.415	34.7



5.5 Test Setup Photographs

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

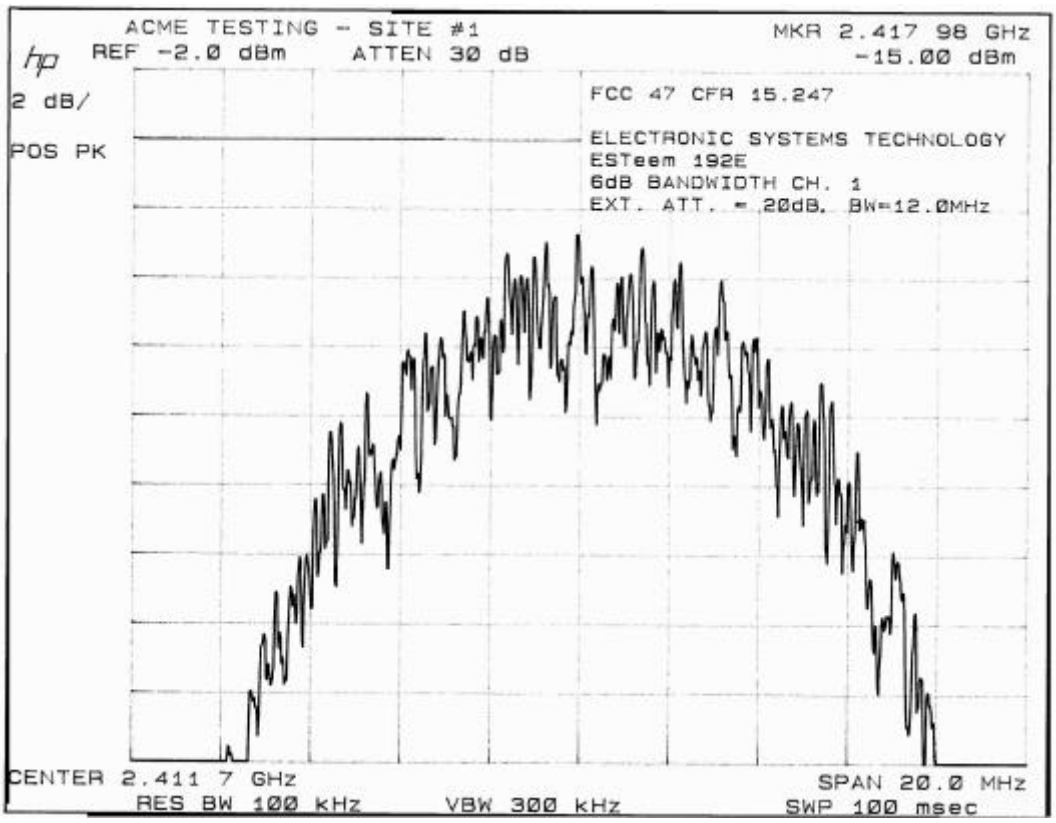
⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

6.3 Test Procedures

An HP 8566B Spectrum Analyzer equipped with an HP 85685A RF Preselector was used to make the 6 dB Bandwidth Measurements. Specifically, the RF output of the EUT was connected via a coaxial cable and a 20 dB pad attenuator to the RF input port of the RF Preselector. The measurements (shown in the plots on the next three pages of this report) were made with the RBW = 100 kHz and the VBW = 300 KHz.

6.4 Test Results

⇒ The measured 6 dB bandwidth at channel 1 is 12.0 MHz.
⇒ The measured 6 dB bandwidth at channel 6 is 12.1 MHz.
⇒ The measured 6 dB bandwidth at channel 11 is 11.8 MHz.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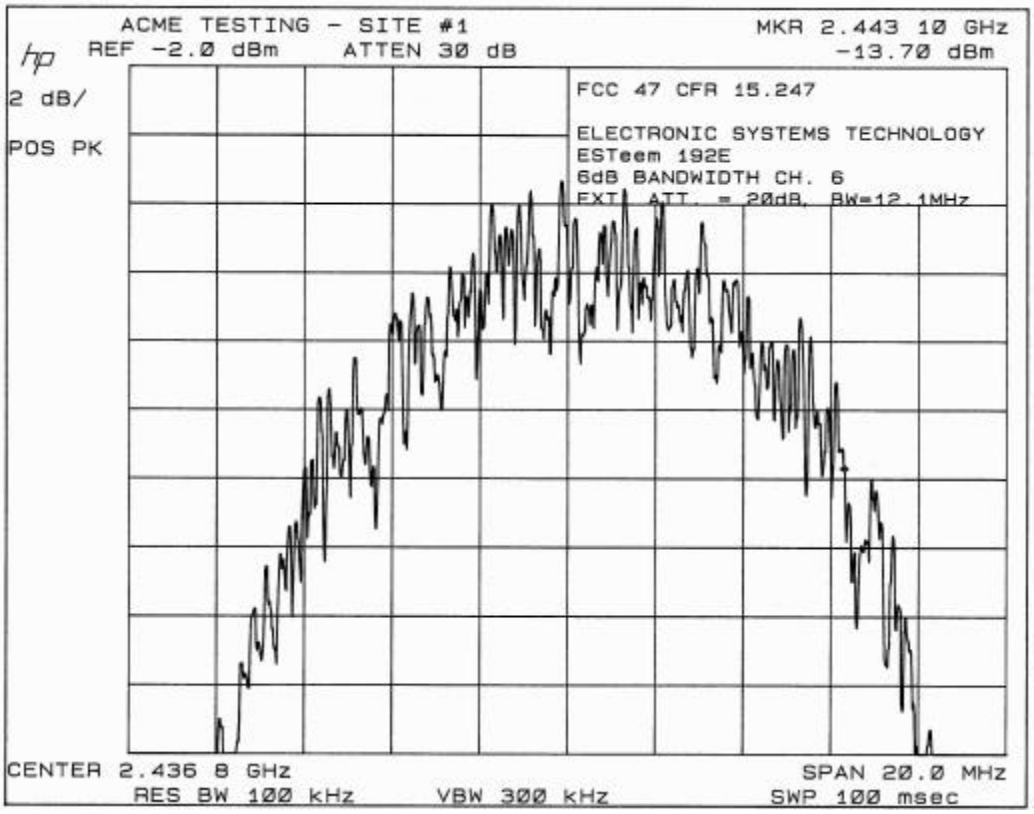
REF -2.0 dBm
ATTEN 30 dB
MKR 2.417 98 GHz
-15.00 dBm
2 dB/
POS PK
FCC 47 CFR 15.247
ELECTRONIC SYSTEMS TECHNOLOGY
ESTeem 192E
6dB BANDWIDTH CH. 1
EXT. ATT. = 20dB, BW=12.0MHz
CENTER 2.411 7 GHz
RES BW 100 kHz
VBW 300 kHz
SPAN 20.0 MHz
SWP 100 msec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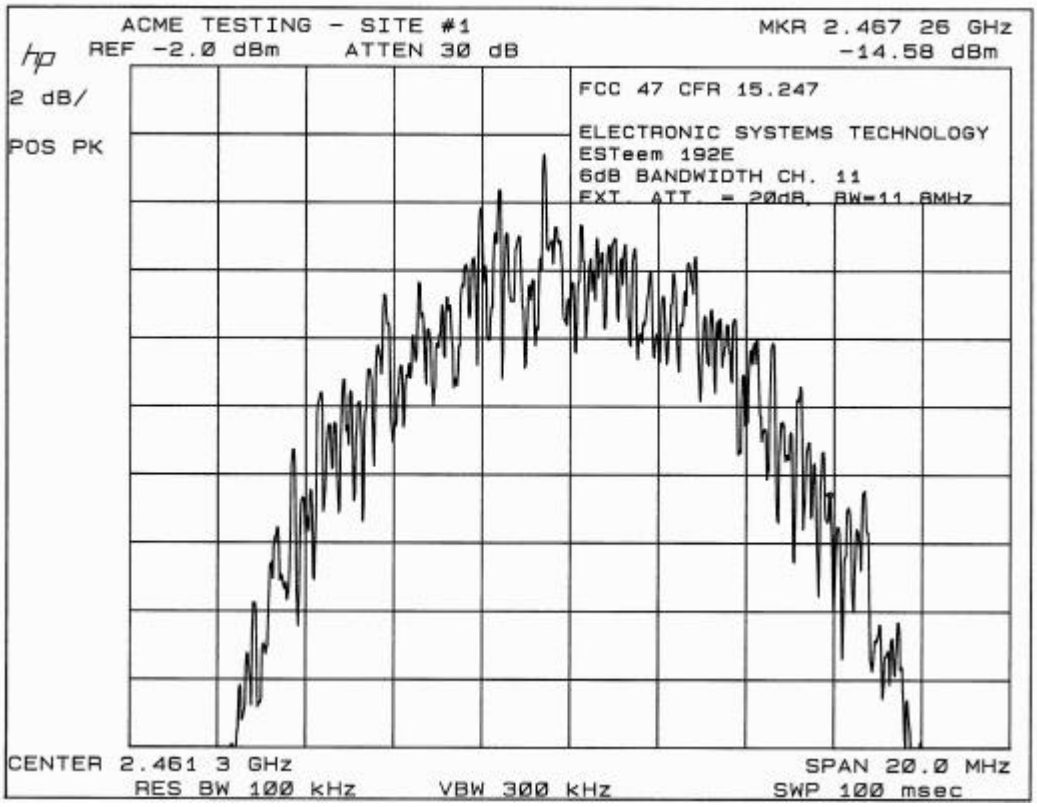
REF -2.0 dBm
ATTEN 30 dB
MKR 2.443 10 GHz
-13.70 dBm
2 dB/
POS PK
FCC 47 CFR 15.247
ELECTRONIC SYSTEMS TECHNOLOGY
ESTeem 192E
6dB BANDWIDTH CH. 6
EXT. ATT. = 20dB, BW=12.1MHz
CENTER 2.436 8 GHz
RES BW 100 kHz
VBW 300 kHz
SPAN 20.0 MHz
SWP 100 msec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MKR 2.467 26 GHz
REF -2.0 dBm
ATTEN 30 dB
-14.58 dBm
2 dB/
POS PK
FCC 47 CFR 15.247
ELECTRONIC SYSTEMS TECHNOLOGY
ESTeem 192E
6dB BANDWIDTH CH. 11
EXT. ATT. = 20dB, BW=11.8MHz
CENTER 2.461 3 GHz
SPAN 20.0 MHz
RES BW 100 kHz
VBW 300 kHz
SWP 100 msec

6.5 Test Setup Photographs

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

⇒ Sensor Module: Hewlett Packard 11722A, Serial Number: 3111A04739, Calibrated: 19 March 2001, Calibration due Date: 19 March 2002

⇒ Precision Attenuator Set: Weinschel AS-18, Serial Number: 665, Calibration Not Required

⇒ Measuring Receiver: Hewlett Packard 8902A, Serial Number: 3216A03958, Calibrated 20 December 2000, Calibration due Date: 20 December 2001

7.3 Test Procedures

An HP 8902A EMI Receiver equipped with an HP 11722 Sensor Module was used to measure the maximum Peak Power Output of the EUT. Specifically, the modulated RF output of the EUT was connected via a coaxial cable and a 20 dB pad attenuator to the RF input port of the EMI Receiver.

7.4 Test Results

⇒ Measured maximum Power for channel 1 was 26.01 dBm.
⇒ Measured maximum Power for channel 6 was 27.38 dBm.
⇒ Measured maximum Power for channel 11 was 26.18 dBm.

8. Conducted Spurious Emissions

8.1 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)).

8.2 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

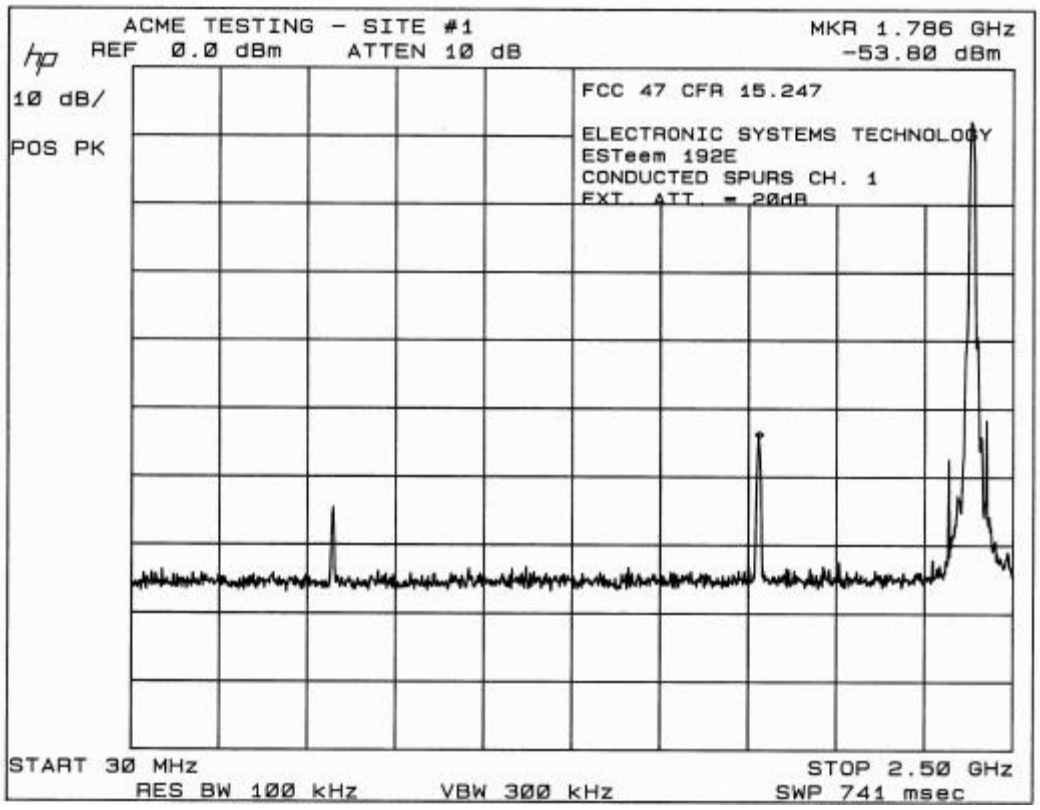
8.3 Test Procedures

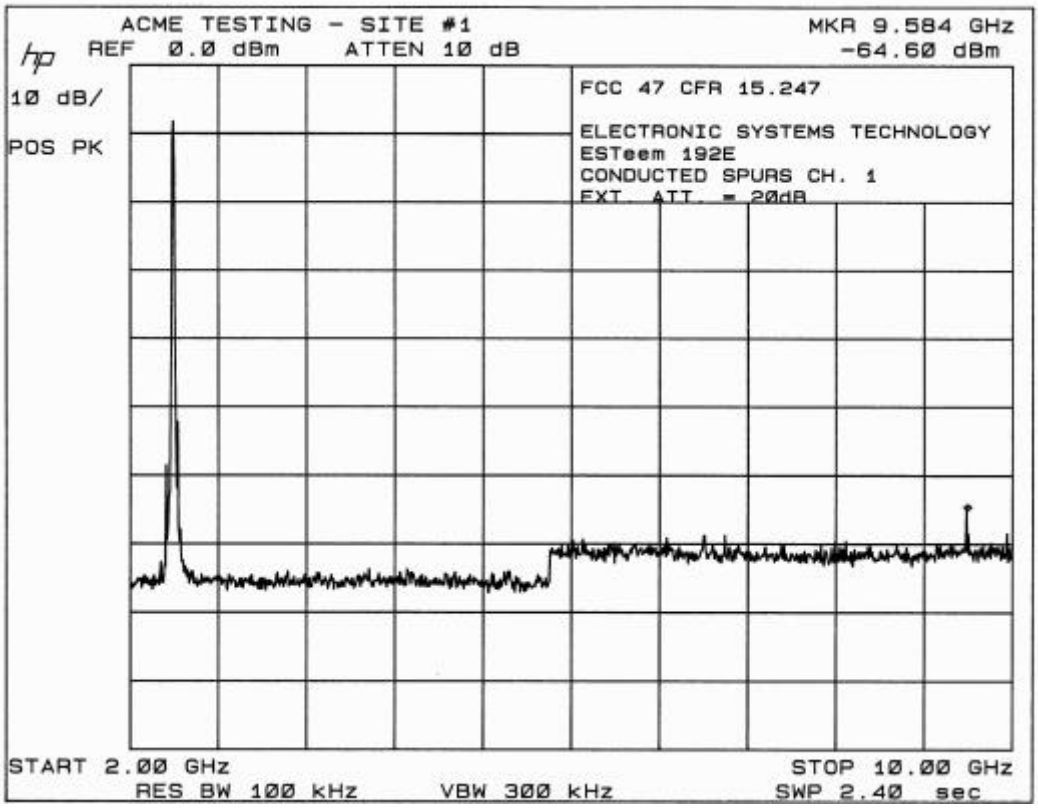
An HP 8566B Spectrum Analyzer equipped with an HP 85685A RF Preselector was used to measure the Conducted Spurious emissions from the EUT. Specifically, the RF output of the EUT was connected via a coaxial cable and a 20 dB pad attenuator to the RF input port of the RF Preselector. The measurements (shown on the next 9 pages of this test report) were made with the RBW = 100 kHz and the VBW = 300 kHz.

8.4 Test Results

No out of band conducted emissions were detected within 40 dB of the carrier power.

CHANNEL 1 CONDUCTED SPURS





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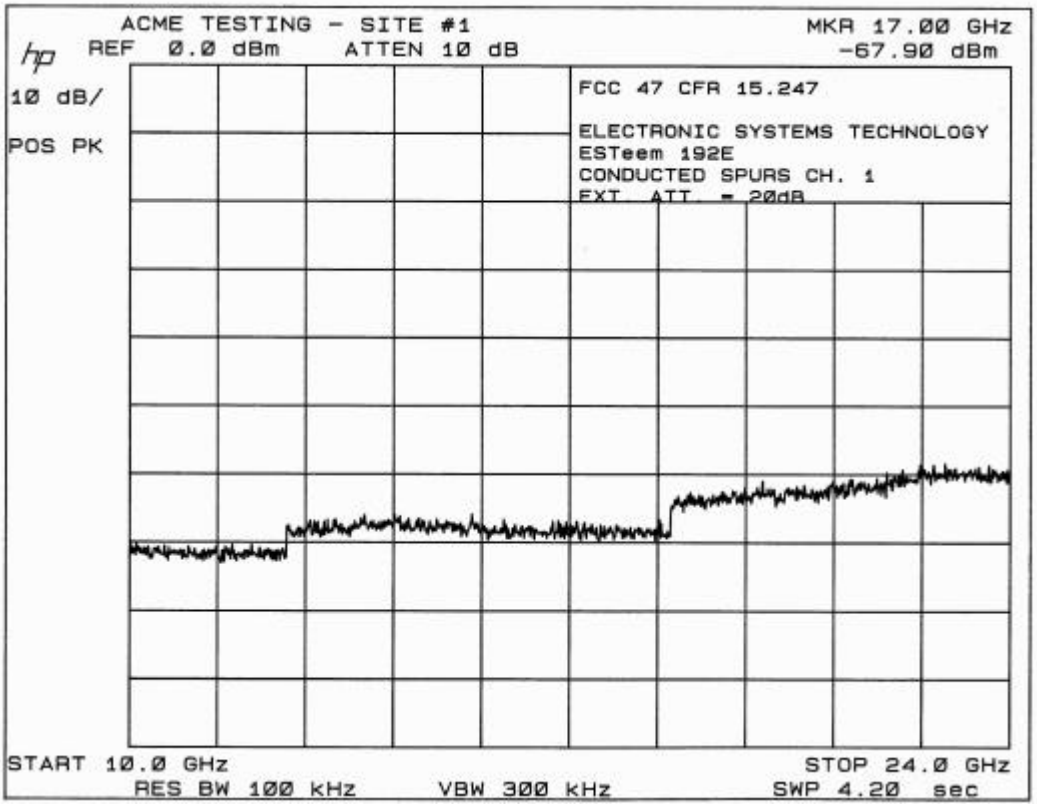
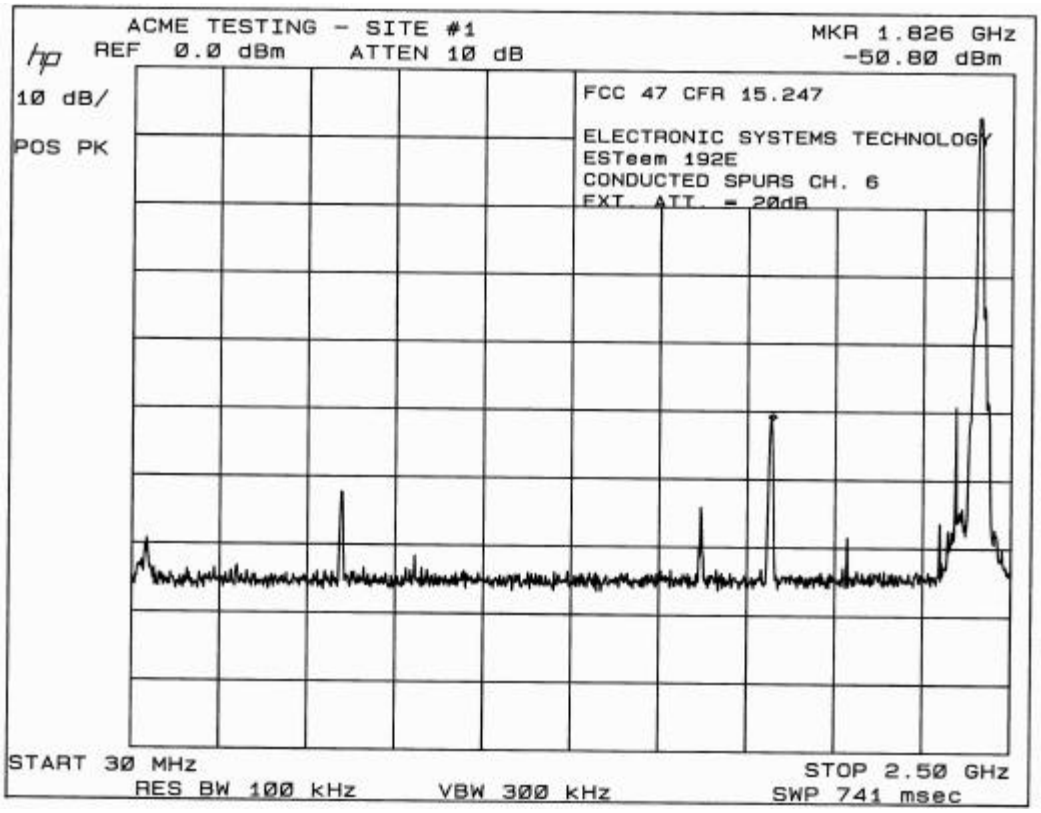
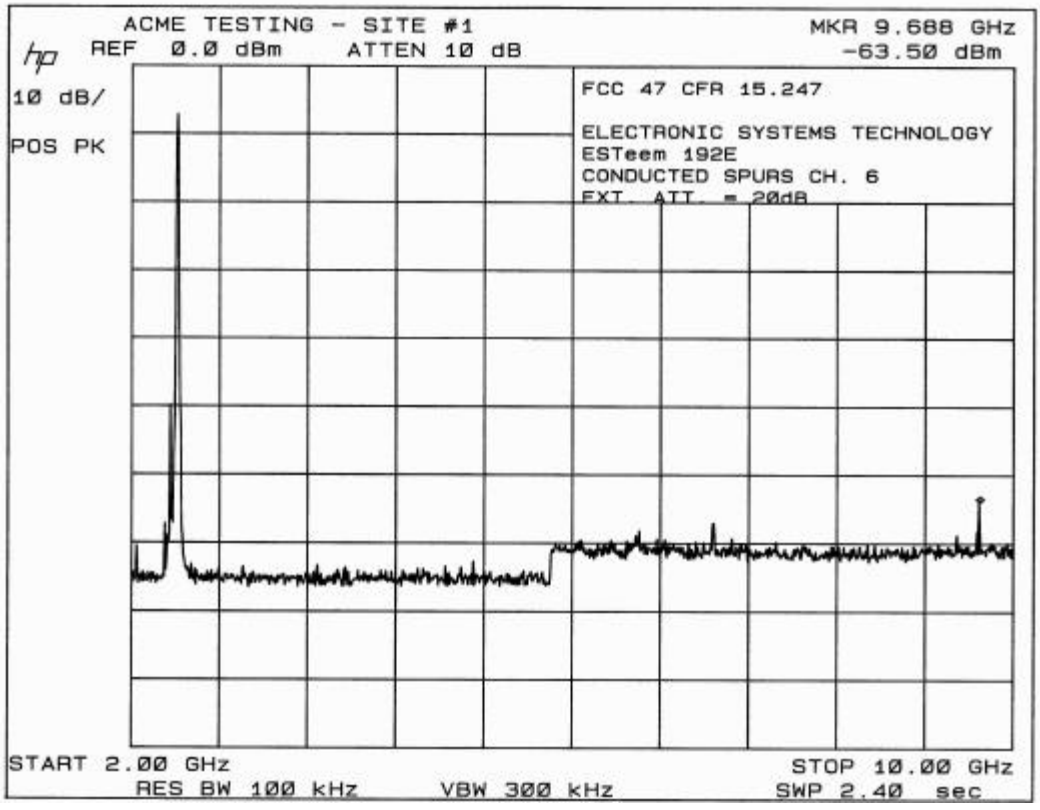
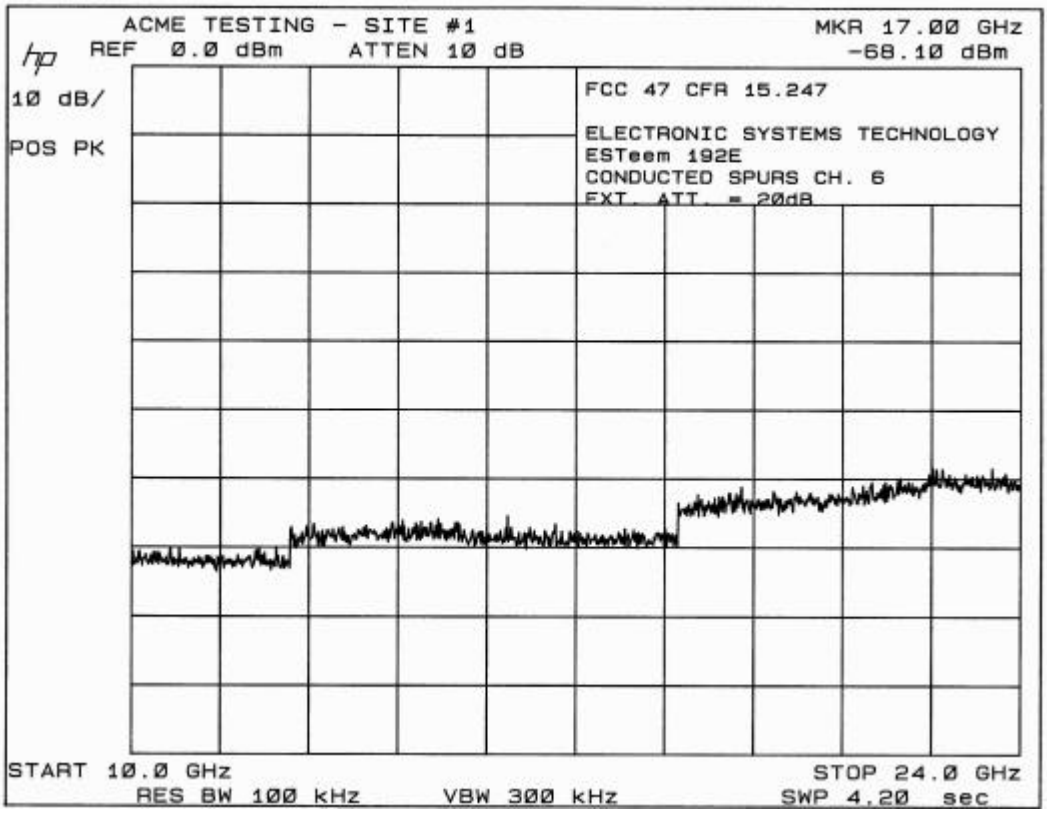
phone:888 226-3837 fax: 360 595-2722



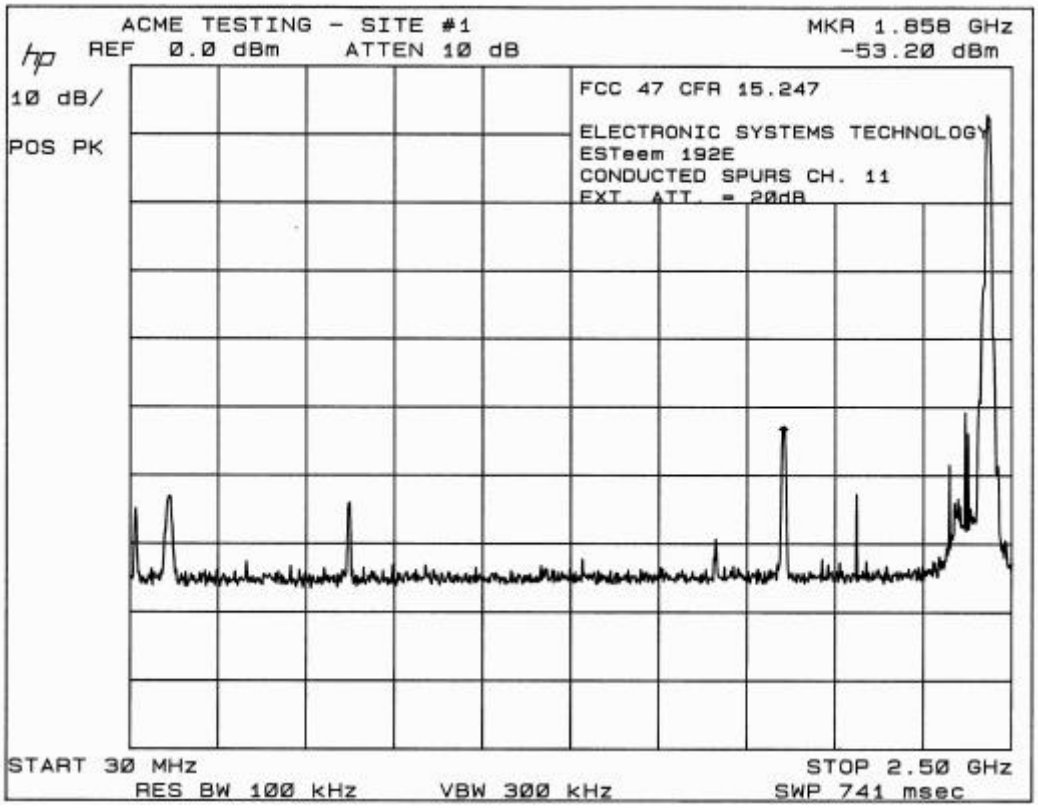
CHANNEL 6 CONDUCTED SPURS

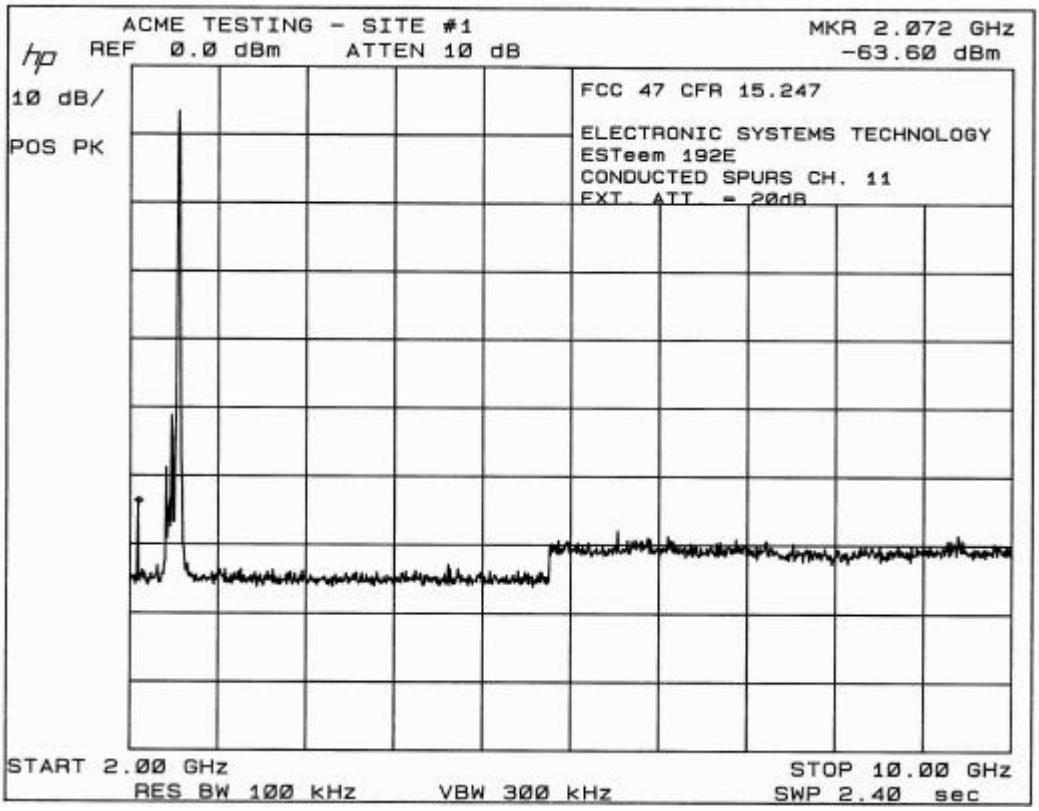


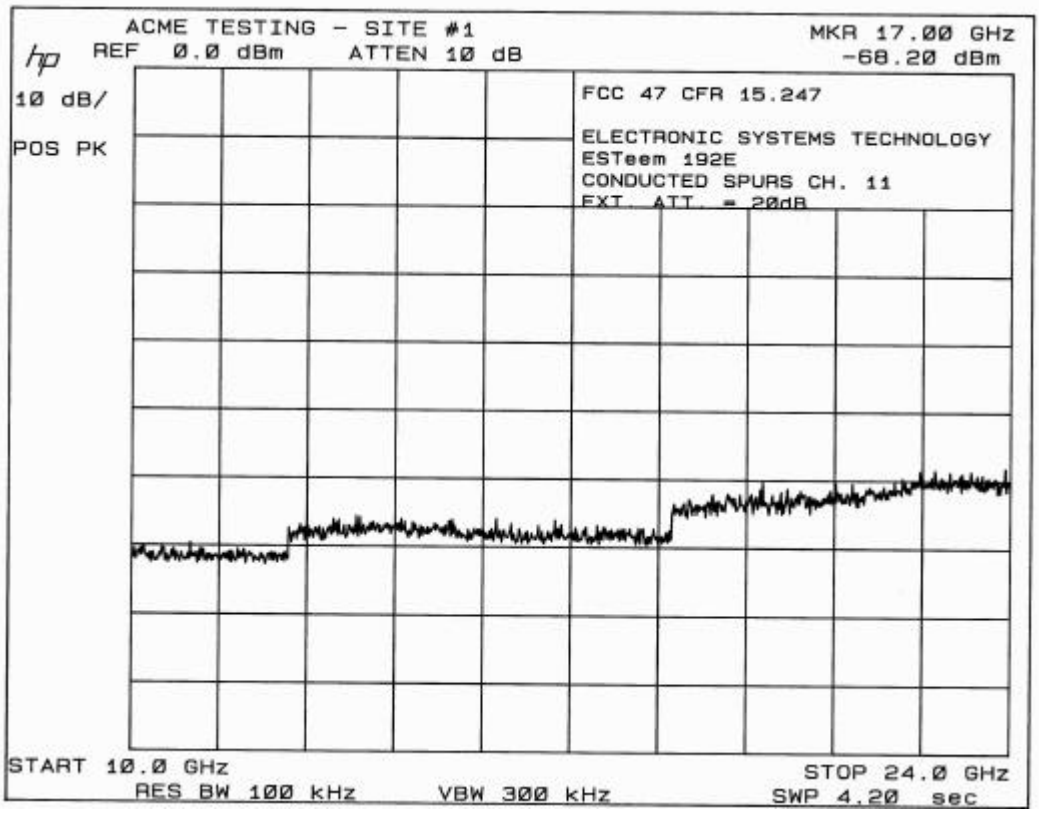



ACME TESTING - SITE #1
MKR 17.00 GHz
REF 0.0 dBm
ATTEN 10 dB
-68.10 dBm
10 dB/
POS PK
FCC 47 CFR 15.247
ELECTRONIC SYSTEMS TECHNOLOGY
ESTeem 192E
CONDUCTED SPURS CH. 6
EXT. ATT. = 20dB
START 10.0 GHz
STOP 24.0 GHz
RES BW 100 kHz
VBW 300 kHz
SWP 4.20 sec

CHANNEL 11 CONDUCTED SPURS






ACME TESTING - SITE #1
REF 0.0 dBm
ATTEN 10 dB
MKR 17.00 GHz
-68.20 dBm
10 dB/
POS PK
FCC 47 CFR 15.247
ELECTRONIC SYSTEMS TECHNOLOGY
ESTeem 192E
CONDUCTED SPURS CH. 11
EXT. ATT. = 20dB
START 10.0 GHz
RES BW 100 kHz
VBW 300 kHz
STOP 24.0 GHz
SWP 4.20 sec

9. Process Gain

9.1 Regulation

(47 CFR 15.247e) 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/dispreading function.

9.2 Test Results

The Jamming Margin Test was performed by the manufacturer of the EUT (i.e. Electronic Systems Technology, Inc.) The Jamming Margin Test report supplied by Electronic Systems Technology, Inc. is attached to this test report.

10. Radiated 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)).

Per the requirements of 47 CFR 15.31(e), the input voltage to the EUT was varied from 85% to 115 % of nominal during measurement of the fundamental of each channel. The values listed are the maximums while the EUT input was varied through this range.

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

⇒ Open Area Test Site: Acme Testing Co., Test Site Number 1, Calibrated: 1 December 2000, Calibration due Date: 1 December 2001

⇒ Broadband Biconical Antenna (blue) (20 MHz to 200 MHz): EMCO 3110, Serial Number 1180, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001

⇒ Broadband Log Periodic Antenna (blue) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 2852, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001

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

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

⇒ Double Ridge Guide Horn Antenna: EMCO 3115, Serial Number 9807-5534, Calibrated: 5 January 2001, Calibration due Date: 5 January 2002

⇒ 1 GHz to 26.5 GHz Preamplifier: Hewlett Packard 8449B, Serial Number 23008A00982, Calibrated: 27 April 2001, Calibration Due Date: 27 April 2002

⇒ 4 GHz High Pass Filter: Microphase HB5000AB, Serial Number 560, Calibration not required.

10.3 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 power supply and antenna.

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 – 24,000 MHz **15.205 RESTRICTED BANDS ONLY**
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz (30 MHz – 1000 MHz) 1 MHz (1000 MHz – 24,000 MHz)
Receive antenna scan height	1 m – 4 m
Receive antenna polarization	Vertical/Horizontal

10.4 Test Setup

The EUT was tested with three different antennas, the AA01S 3dB gain omnidirectional ("rubber duck"), the AA20S 5dB gain omnidirectional, and the AA202S 15.9dB gain directional. The AA01S was tested directly connected to the EUT, the AA20S was tested in an indoor configuration, and the AA202S was tested in an outdoor configuration.

10.5 Test Results

AA01S Antenna
3dB Omnidirectional ("Rubber Duck")
Indoor Configuration

EMISSION FREQUENCY MHz	SPEC LIMIT dBuV/m	MEASUREMENTS ABS	dLIM dB	MODE	POL	ANT HGT cm	AZM deg	NOTES
4823.60	54	27.0	-27.0	PK	V	-	-	channel 1 harm*
4873.10	54	27.8	-26.2	PK	V	-	-	channel 6 harm*
4923.30	54	27.8	-26.2	PK	V	-	-	channel 11 harm*
7235.40	74	63.6	-10.4	PK	V	109	194	channel 1 harm
7309.65	74	58.5	-15.5	PK	V	116	359	channel 6 harm
7384.95	74	56.1	-17.9	PK	V	100	130	channel 11 harm
7235.40	54	53.1	-.9	AVG	V	109	194	channel 1 harm
7309.65	54	48.5	-5.5	AVG	V	116	359	channel 6 harm
7384.95	54	46.7	-7.3	AVG	V	100	130	channel 11 harm
12059.00	54	42.3	-11.7	AVG	V	-	-	channel 1 harm*
12182.75	54	42.4	-11.6	AVG	V	-	-	channel 6 harm*
12308.25	54	42.3	-11.7	AVG	V	-	-	channel 11 harm*
14470.80	54	47.3	-6.7	AVG	V	-	-	channel 1 harm*
19294.40	54	-	-	NM	V	-	-	channel 1 harm**
19492.40	54	-	-	NM	V	-	-	channel 6 harm**
19693.20	54	-	-	NM	V	-	-	channel 11 harm**
22154.85	54	-	-	NM	V	-	-	channel 11 harm**

* Note: No signal was found at this frequency. The amplitude of the limit line was taken to document that there was sufficient sensitivity.

** Note: No measurement was taken based on engineering judgment (lesser harmonics were not close to failing).

AA20S Antenna
5 dB Omnidirectional Indoor Configuration

	EMISSION FREQUENCY MHz	SPEC LIMIT dBuV/m	MEASUREMENTS ABS	dLIM dB	MODE	POL	ANT HGT cm	AZM deg	NOTES	
1	2412.3	94.0	121.0	27.5	PK	V	123	20	-5.3	channel 1 harm
2	2437.6	94.0	118.2	24.2	PK	V	142	170	-5.2	channel 6 harm
3	2462.38	94.0	122.0	28.7	PK	V	139	79	-5.2	channel 11 harm
4	4823.6	74.0	43.4	-30.6	PK	V	123	20	0.4	channel 1 harm*
5	4873.1	74.0	47.4	-26.6	PK	V	140	169	0.5	channel 6 harm
6	4921.1	74.0	45.4	-28.6	PK	V	127	54	0.7	channel 11 harm
7	7237.0	74.0	56.6	-17.4	PK	V	135	28	5.6	channel 1 harm
8	7239.4	54.0	47.9	-6.1	AVG	V	135	28	5.6	channel 1 harm
9	7307.7	54.0	52.2	-1.8	AVG	V	142	170	5.7	channel 6 harm
10	7309.6	74.0	61.9	-12.1	PK	V	142	170	5.7	channel 6 harm
11	7384.9	74.0	61.6	-12.4	PK	V	126	214	5.7	channel 11 harm
12	7389.25	54.0	52.3	-1.7	AVG	V	126	214	5.7	channel 11 harm
13	12059.0	74.0	52.7	-21.3	PK	V	135	28	9.9	channel 1 harm*
14	12060.0	54.0	43.6	-10.4	AVG	V	135	28	9.9	channel 1 harm
15	12182.8	74.0	54.1	-20.1	PK	V	142	170	10.7	channel 6 harm
16	12183.0	54.0	44.7	-9.3	AVG	V	142	170	10.7	channel 6 harm
17	12308.3	74.0	55.5	-21.5	PK	V	126	214	11.1	channel 11 harm*
18	12309.0	54.0	44.8	-9.2	AVG	V	126	214	11.1	channel 3 harm
19	14470.8	54.0	56.4	2.4	PK	V	135	28	13.6	channel 1 harm*
20	14471.0	54.0	47.0	-7.0	PK	V	135	28	13.6	channel 1 harm

* Note: No signal was found at this frequency. The amplitude of the limit line was taken to document that there was sufficient sensitivity.

AA202S Antenna
13.9 dB Directional
Outdoor Configuration

EMISSION FREQUENCY MHz	SPEC LIMIT dBuV/m	MEASUREMENTS ABS	dLIM dB	MODE	POL	ANT HGT cm	AZM deg	NOTES
4820.90	54	42.0	-12.0	PK	V	-	-	channel 1 harm*
4873.80	54	45.4	-8.6	PK	V	125	353	channel 6 harm
4923.30	54	41.6	-12.4	PK	V	-	-	channel 11 harm*
7233.00	74	54.4	-19.6	PK	V	155	346	channel 1 harm
7314.00	74	59.7	-14.3	PK	V	145	349	channel 6 harm
7384.70	74	59.4	-14.6	PK	V	155	346	channel 11 harm
7239.50	54	46.5	-7.5	AVG	V	155	346	channel 1 harm
7314.10	54	50.7	-3.3	AVG	V	145	349	channel 6 harm
7385.10	54	49.4	-4.6	AVG	V	155	346	channel 11 harm
12058.00	54	41.9	-12.1	AVG	V	-	-	channel 1 harm*
12183.00	54	42.9	-11.1	AVG	V	-	-	channel 6 harm*
12308.30	54	42.8	-11.2	AVG	V	-	-	channel 11 harm*
14471.80	54	41.8	-12.2	AVG	V	-	-	channel 1 harm*
19294.40	54	-	-	NM	V	-	-	channel 1 harm**
19492.40	54	-	-	NM	V	-	-	channel 6 harm**
19693.20	54	-	-	NM	V	-	-	channel 11 harm**
22154.85	54	-	-	NM	V	-	-	channel 11 harm**

* Note: No signal was found at this frequency. The amplitude of the limit line was taken to document that there was sufficient sensitivity.

** Note: No measurement was taken based on engineering judgment (lesser harmonics were not close to failing).

10.6 Test Setup Photographs

11. Peak Power Spectral Density

11.1 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.

11.2 Test Equipment

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

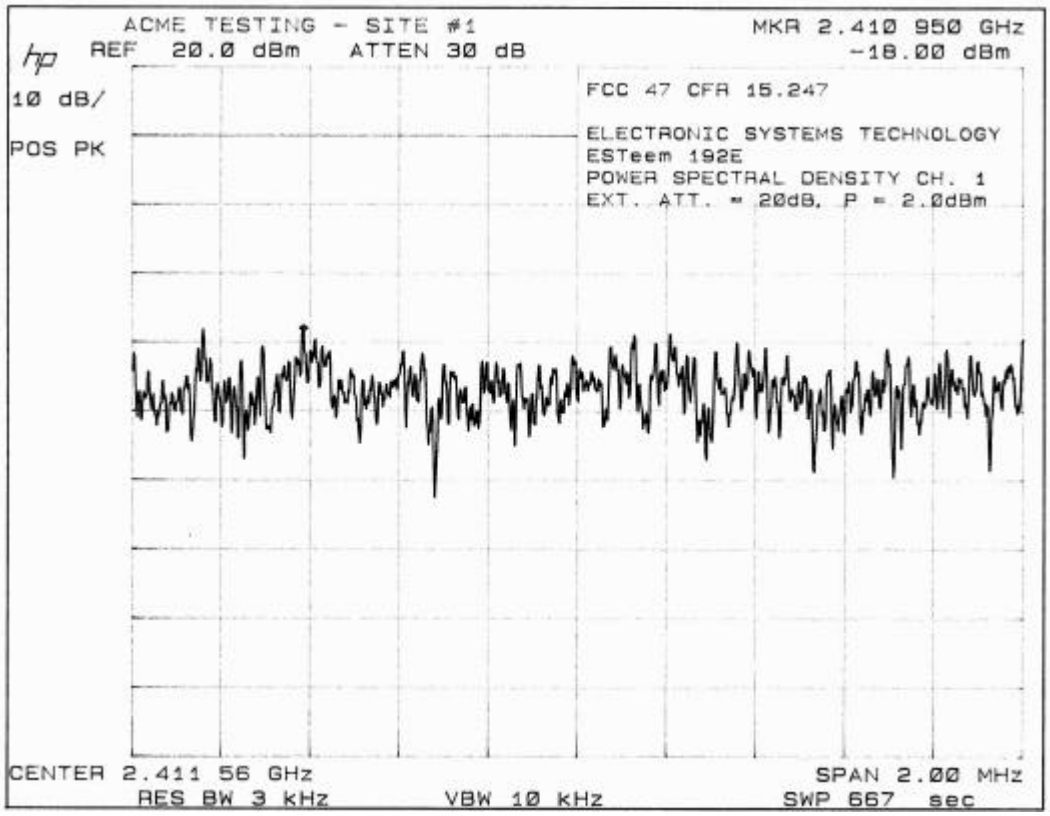
⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001

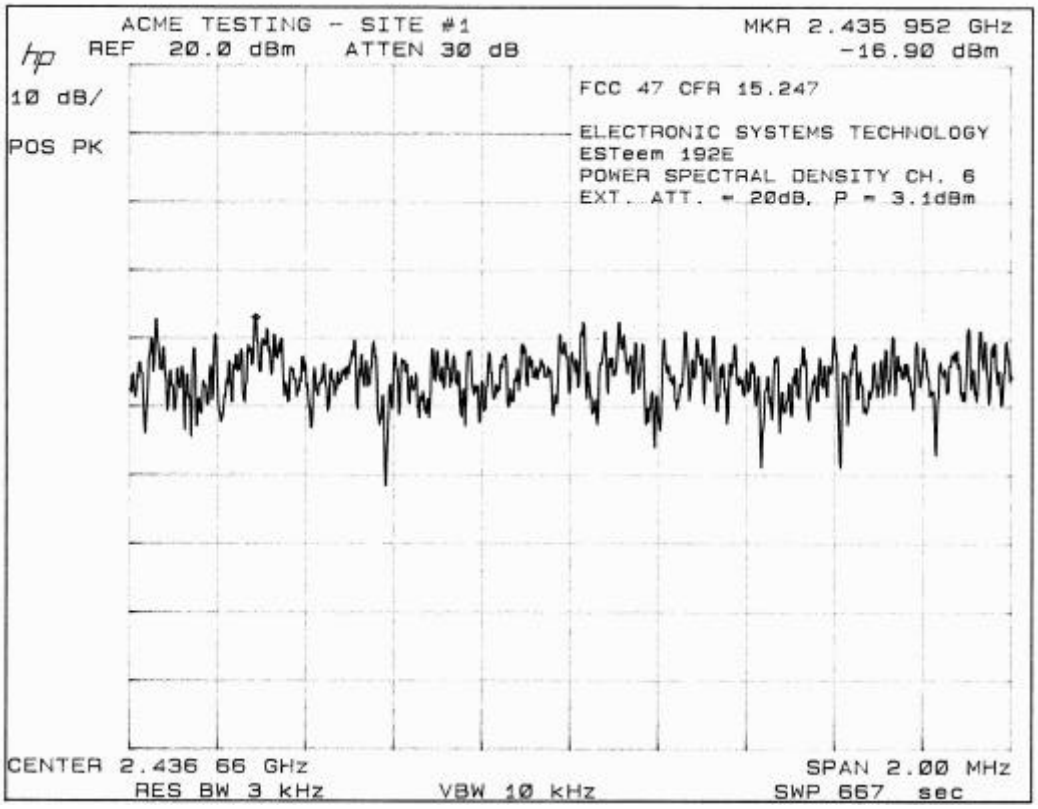
11.3 Test Procedures

AN HP 8566B Spectrum Analyzer equipped with an HP 85685A RF Preselector was used to measure the Peak Power Spectral Density. Specifically, the RF output of the EUT was connected via an RF coaxial cable and a 20 dB pad attenuator to the RF input port of the RF Preselector. The measurements (shown in the next 3 pages of this test report) were made with the RBW = 3 kHz, the VBW = 10 kHz, and the Sweep Time = 666 seconds.

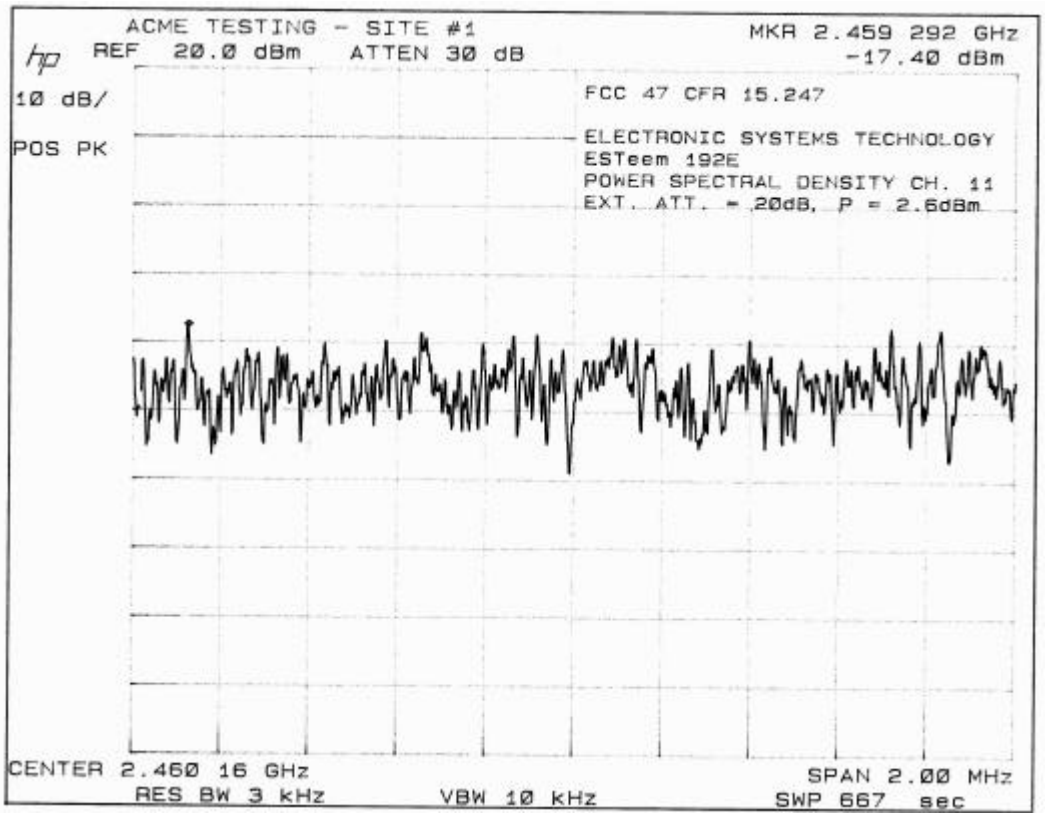
11.4 Test Results

Maximum peak power spectral density of channel 1 is 2.0 dBm.
Maximum peak power spectral density of channel 6 is 3.1 dBm.
Maximum peak power spectral density of channel 11 is 2.6 dBm.


ACME TESTING - SITE #1
MKR 2.410 950 GHz
REF 20.0 dBm ATTEN 30 dB
-18.00 dBm
10 dB/
POS PK
FCC 47 CFR 15.247
ELECTRONIC SYSTEMS TECHNOLOGY
ESTeem 192E
POWER SPECTRAL DENSITY CH. 1
EXT. ATT. = 20dB, P = 2.0dBm
CENTER 2.411 56 GHz
SPAN 2.00 MHz
RES BW 3 kHz
VBW 10 kHz
SWP 667 sec


ACME TESTING - SITE #1
MKR 2.435 952 GHz
REF 20.0 dBm ATTEN 30 dB
-16.90 dBm
10 dB/
POS PK
FCC 47 CFR 15.247
ELECTRONIC SYSTEMS TECHNOLOGY
ESTeem 192E
POWER SPECTRAL DENSITY CH. 6
EXT. ATT. = 20dB, P = 3.1dBm
CENTER 2.436 66 GHz
SPAN 2.00 MHz
RES BW 3 kHz
VBW 10 kHz
SWP 667 sec

2002 Valley Highway PO Box 3 Acme WA 98220-0003
phone:888 226-3837 fax: 360 595-2722



12. Band Edge

12.1 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)).

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

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

⇒ Open Area Test Site: Acme Testing Co., Test Site Number 1, Calibrated: 1 December 2000, Calibration due Date: 1 December 2001

⇒ Broadband Biconical Antenna (blue) (20 MHz to 200 MHz): EMCO 3110, Serial Number 1180, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001

⇒ Broadband Log Periodic Antenna (blue) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 2852, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001

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

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

⇒ Double Ridge Guide Horn Antenna: EMCO 3115, Serial Number 9807-5534, Calibrated: 5 January 2001, Calibration due Date: 5 January 2002

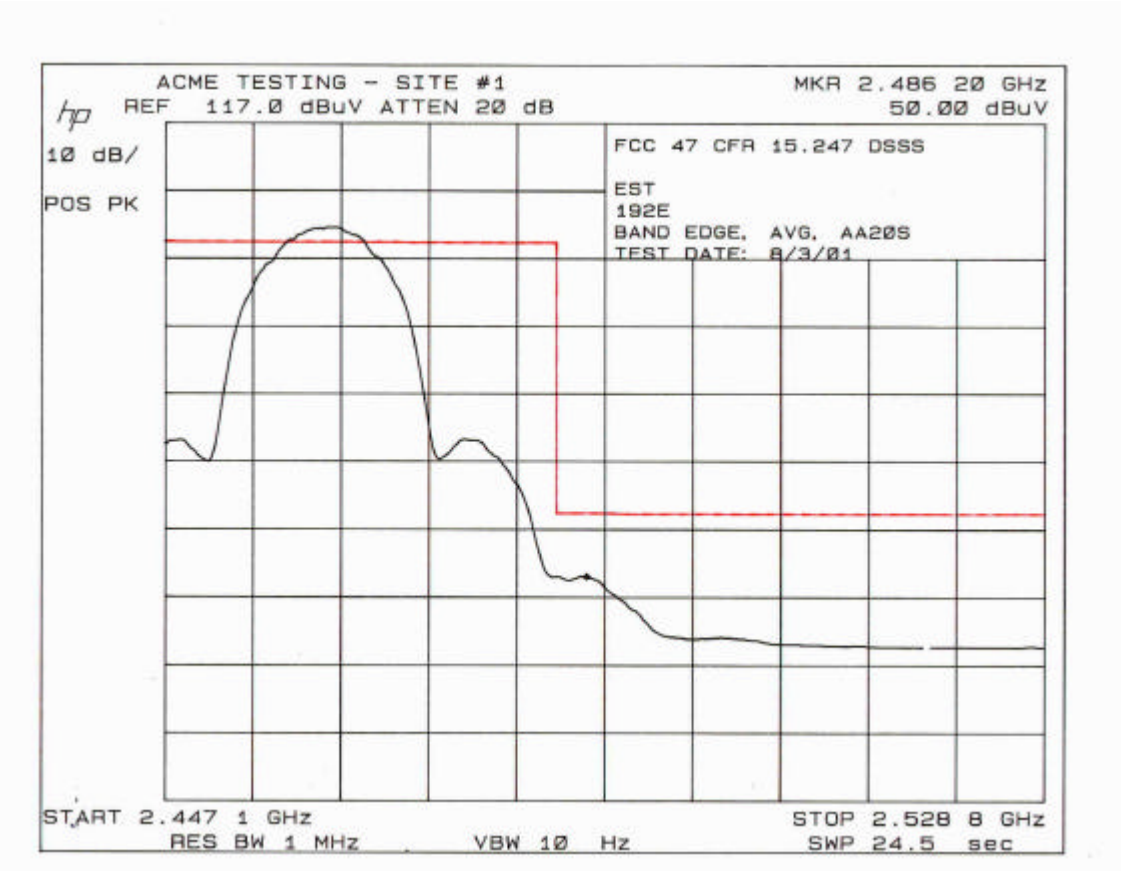
⇒ 1 GHz to 26.5 GHz Preamplifier: Hewlett Packard 8449B, Serial Number 23008A00982, Calibrated: 27 April 2001, Calibration Due Date: 27 April 2002

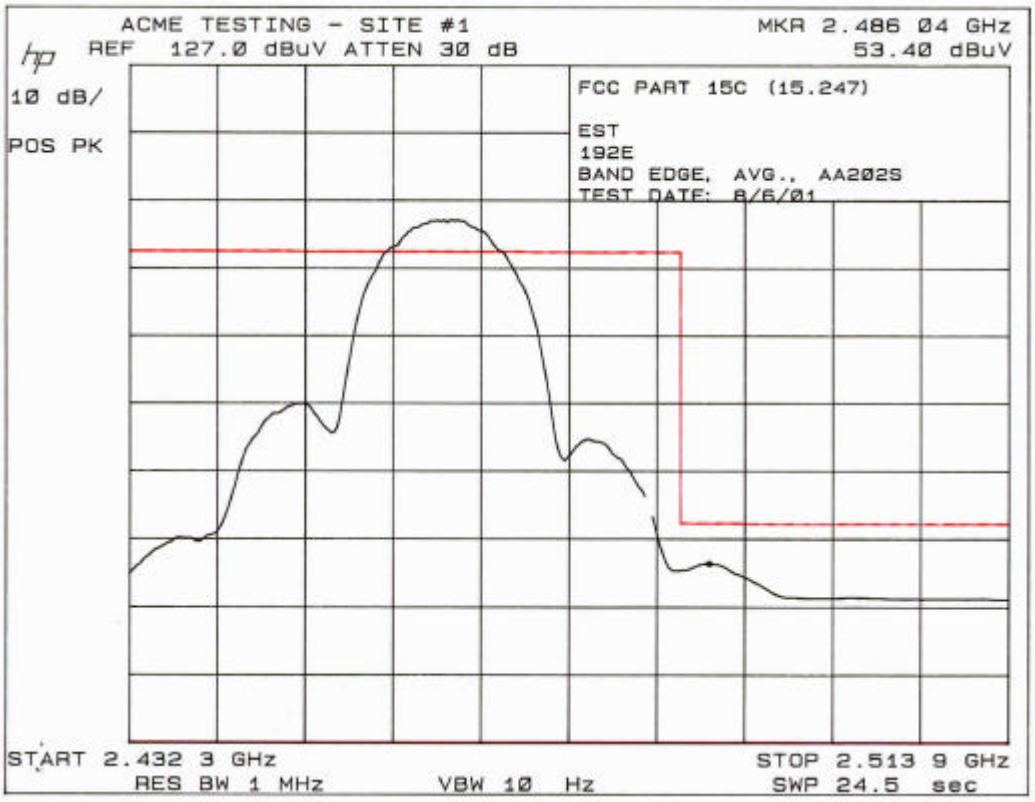
⇒ 4 GHz High Pass Filter: Microphase HB5000AB, Serial Number 560, Calibration not required.

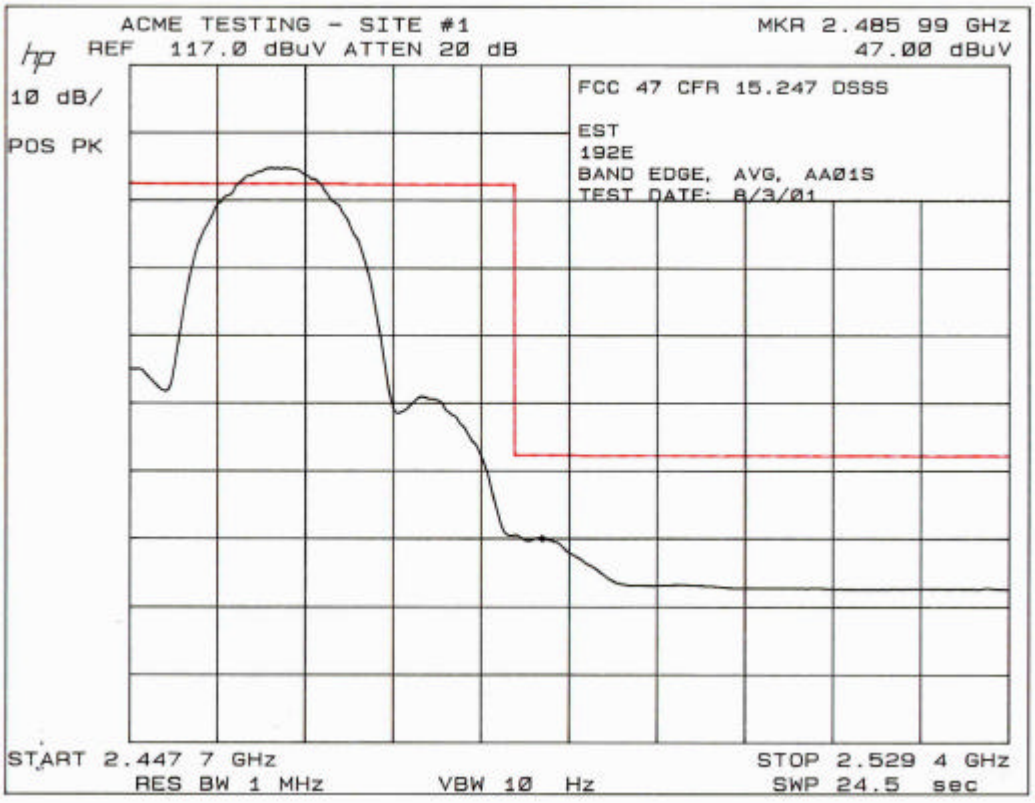
12.3 Test Procedures

An HP 8566B Spectrum Analyzer was used to measure the Radiated emissions from the EUT. An external pad was used to prevent the Spectrum Analyzer from going into compression. The fundamental emission was then measured against the band limits while the EUT was operating in its highest and lowest channels. With the RBW and VBW set to 100kHz, the delta between the highest signal peak outside the band and the highest peak inside the band was measured against the 20dB limit. Additionally, the average value of signal strength beginning at the 2483.5 MHz restricted band was measured.

12.4 Test Results




ACME TESTING - SITE #1
MKR 2.486 04 GHz
REF 127.0 dBuV ATTEN 30 dB
53.40 dBuV
10 dB/
POS PK
FCC PART 15C (15.247)
EST
192E
BAND EDGE, AVG., AA202S
TEST DATE: 8/6/01
START 2.432 3 GHz
STOP 2.513 9 GHz
RES BW 1 MHz
VBW 10 Hz
SWP 24.5 sec


ACME TESTING - SITE #1
MKR 2.485 99 GHz
REF 117.0 dBuV ATTEN 20 dB
47.00 dBuV
10 dB/
POS PK
FCC 47 CFR 15.247 DSSS
EST
192E
BAND EDGE, AVG, AA01S
TEST DATE: 8/3/01
START 2.447 7 GHz
STOP 2.529 4 GHz
RES BW 1 MHz
VBW 10 Hz
SWP 24.5 sec

13. RF Exposure

13.1 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.

13.2 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 is categorically exempt from routine environmental evaluation per section 2.1093.

Included are calculations that determine that minimum distance 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 Radiofrequency Electromagnetic Fields".

13.3 Calculations

Per Table 1 of Section 1.1310, the MPE Limit for general population exposure at 2412 to 2462 MHz is $S=1.0\ mW/cm^2$.

For Antenna AA01S:

Per OET Bulletin 65, Edition 97-01, the formula for calculating Power Density is: $S = (PG)/(4\eth R^2)$ with:

Power = 27.38 dBm = 547 mW = P

Gain of Antenna = 0 dBi (i.e. a numeric gain of G = 1.0) This antenna directly connects to the antenna port.

Therefore, solving for R gives a minimum safe distance of 6.6 cm.

For Antenna AA025:

Per OET Bulletin 65, Edition 97-01, the formula for calculating Power Density is: $S=(PG)/(4\eth R^2)$ with:

Power Output at the antenna port of the transmitter = 27.38 dBm = 547 mW

Gain of Antenna = 5 dBd = 5-2.14 = 2.86 dBi = (numeric gain) = G = 1.93

(Minimum) Cable Loss: 25ft of RG8 Coaxial cable = 2.75 dB

Power at the Antenna Feed Point = 27.38 dBm – 2.75 dB = 24.63 dBm = 290.4 mW = P

$S = 1\ mW/cm^2$

Solving for R: R = 6.7 cm

For Antenna AA202S:

Per OET Bulletin 65, Edition 97-01, the formula for calculating power density is: $S = (PG)/(4\eth R^2)$ with:

Power Output at the antenna port of the transmitter= 27.38 dBm = 547 mW
Gain of Antenna = 13.9 dBd = 13.9-2.14 = 11.76 dBi = (Numeric Gain) G = 15.0
(Minimum) Cable Loss: 25ft of RG-8 Coaxial cable= 2.75 dB
Power at the antenna Feed Point: P = 27.38 dBm –2.75 dB = 24.63 dBm = 290.4 mW = P
$S = 1\ mW/cm^2$

Solving for R: R = 18.6 cm

13.4 Conclusion

The manufacturer's specify this minimum safe distance in the User's Manual.

14. Miscellaneous Comments and Notes

1. None

15. List of Attachments

1. Jamming Margin Test Report (4).

16. Informative Information

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*)

Peter Mayer

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

2002 Valley Highway PO Box 3 Acme WA 98220-0003
phone:888 226-3837 fax: 360 595-2722

Laboratory Division
7435 Oakland Mills Road
Columbia, MD. 21046

November 22, 1999

Registration Number: 90420

Acme Testing Company
P.O. Box 3
2002 Valley Highway
Acme, WA 98220-0003

Attention: Paul Slavens

Re: Measurement facility located at Acme, Sites 1 & 2
3, 10 & 30 meter sites
Date of Listing: November 22, 1999

Gentlemen:

Your submission of the description of the subject measurement facility has been reviewed and found to be in compliance with the requirements of Section 2.948 of the FCC Rules. The description has, therefore, been placed on file and the name of your organization added to the Commission's list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that this filing must be updated for any changes made to the facility, and at least every three years from the date of listing the data on file must be certified as current.

If requested, the above mentioned facility has been added to our list of those who perform these measurement services for the public on a fee basis. An up-to-date list of such public test facilities is available on the Internet on the FCC Website at WWW.FCC.GOV, E-Filing, OET Equipment Authorization Electronic Filing.

Sincerely,

Thomas W Phillips
Electronics Engineer