The University of Michigan
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Measured Radio Frequency Emissions From

C-Spec Wireless Bridge Model RF-2A (with Amplifier) (Transmitter)

Report No. 415031-869
August 10, 1997

For:
C-Spec Corporation
20 Marco Lane
Dayton, OH 45458

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Tests supervised by:
Report approved by: Valdis V. Liepa
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Summary

Tests for compliance with FCC Regulations subject to Part 15 were performed on C-Spec spread spectrum RF link. The DUT is subject to Regulations as a transmitter, and as a digital device. This link uses an already certified spread spectrum RF modem, but with different RF cables, antennas, and added Power amplifier and bandpass filter. Here we report measurements of radiated emissions in restricted bands. The other measurements, such as Antenna Conducted Power, Spectral Power Density, etc., follow this report.

In testing performed on March 13 and 14, 1997 the device tested in the worst case met the allowed specifications for radiated emissions in restricted bands by at least 4.1 dB (see pp. 7-9).

1. Introduction

C-Spec Wireless Bridge, Model RF-2A, was tested for compliance with FCC Regulations, Part 15, adopted under Docket 87-389, April 18, 1989. The tests were performed at the University of Michigan Radiation Laboratory Willow Run Test Range following the procedures described in ANSI C63.4-1992 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The attenuation characteristics of the Open Site facility are on file with FCC Laboratory, Columbia, Maryland. (FCC file 31040/SIT)

2. Test Procedure and Equipment Used

The test equipment commonly used in our facility is listed in Table 2.1 below. The second column identifies the specific equipment used in these tests. The HP 8593E spectrum analyzer is used for primary amplitude and frequency reference.

Table 2.1. Test Equipment.

Test Instrument	Equipment Used	Manufacturer/Model	Cal. Date/By
Spectrum Analyzer (9kHz-22GHz)		Hewlett-Packard 8593A SN: 3107A01358	February 1996/HP
Spectrum Analyzer (9kHz-26GHz)	X	Hewlett-Packard 8593E SN: 3107A01131	August 1996/HP
Spectrum Analyzer (0.1-1500 MHz)		Hewlett-Packard 182T/8558B SN: 1529A01114/543592	August 1996/U of M Rad Lab
Preamplifier (5-1000MHz)		Watkins-Johnson A11 -1 plus A25-1S	May 1996/U of M Rad Lab
Preamplifier (5-4000 MHz)		Avantek	Nov. 1992/ U of M Rad Lab
Power Meter w/ Thermistor		Hewlett-Packard 432A Hewlett-Packard 478A	August 1989/U of M Rad Lab August 1989/U of M Rad Lab
Broadband Bicone (20-200 MHz)		University of Michigan	July 1988/U of M Rad Lab
Broadband Bicone (200-1000 MHz)		University of Michigan	June 1993/U of M Rad Lab
Dipole Antenna Set (30-1000 MHz)		EMCO 3121C SN: 992	February 1994/EMCO
S-Band Std. Gain Horn	X	S/A, Model SGH-2.6	Manufacturer, NRL design
C-Band Std. Gain Horn	X	University of Michigan	Manufacturer, NRL design
XN-Band Std. Gain Horn	X	University of Michigan	Manufacturer, NRL design
X-Band Std. Gain Horn	X	S/A, Model 12-8.2	Manufacturer, NRL design
Ku-Band Std. Gain Horn	X	University of Michigan	Manufacturer, NRL design
K-Band Std. Gain Horn	X	University of Michigan	Manufacturer, NRL design
Ridge-horn Antenna (0.5-5 GHz)		University of Michigan	February 1991/U of M Rad Lab
LISN Box		University of Michigan	May 1994/U of M Rad Lab
Signal Cables	X	Assorted	January 1993/U of M Rad Lab
X-Y Recorder		Hewlett-Packard 7046A	During Use/U of M Rad Lab
Signal Generator (0.1-990 MHz)		Hewlett-Packard 8656A	January 1990/U of M Rad Lab
EMI/Fld Int. Meter (30-1000 MHz)		Stoddard NM-37/57A SN: 0606-80119	August 1989/U of M Rad Lab
Printer	X	Hewlett-Packard 2225A	August 1989/HP

3. Configuration and Identification of Device Under Test

The DUT is a spread spectrum rf wireless link operating in 2400 - 2483.5 MHz band. The system to be certified consists of ta PC containing a Lucent RF card, cables, amplifier, filter, and choice of nine antennas.

The DUT can operate on any of the seven channels in 2.412 - 2.462 MHz range. In this report we report measurements of emissions in Restricted Bands. Nine antennas are included. Most emissions were unmeasurable, even at a 1 m distance. Tests were performed for the lowest, mid, and highest channels.

The DUT was designed and will be manufactured by C-Spec Corporation, 20 Marco Lane, Dayton, OH 45458. It is identified as:

C-Spec Wireless Bridge
Model: RF-2A
SN: 003
FCC ID: MBX-OLANWB2A

Components to be certified:

RF Modem Card, Lucent	SN: 003 FCC ID: IMR24HAT(issued to Lucent) CAN: 2301 01 778A
Antenna, Omni, H-pol Model 200A801 G=8.15 dBi	SN: none FCC ID: n/a
Antenna, V-pol Model 200A901, G=8.1 dBi	SN: none FCC ID: n/a
Antenna, Omni, V-pol Model 2426AA, 5.0 dBi	SN: none FCC ID: n/a
Antenna, V-pol Model A02-12, 12.4 dBi	SN: none FCC ID: n/a
Antenna, Circ.-pol Model 2415AB, 13.5 dBi	SN: none FCC ID: n/a
Antenna, Circ.-pol, indoor Model ANT2HU801, 8.5 dBi	SN: none FCC ID: n/a
Antenna, H-pol Model 2CON1001, 10.0 dBi	SN: none FCC ID: n/a
Antenna, H-pol Model 2CON1701, 17.0 dBi	SN: none FCC ID: n/a
Antenna, H-pol Model 2CON2301, 23.0 dBi	SN: none FCC ID: n/a

Cables :
RG-8/U (Belden 9913), 25 ft, used in the tests
RG-8/U (Belden 9913), 50 ft, used in the tests.

Bandpass Filter, C-Spec (used only with 2CON1701 and 2CON2301 antennas)	SN: proto
Attenuators, 3 dB and 10 dB, GenRad	SN: none
Amplifier, C-Spec, 2.4 GHz Model AMP20	SN: 707112

3.1 EMI Relevent Modifications

None.

4. Emission Limits

4.1 Radiated Emission Limits

Since the DUT is a spread spectrum device, the radiated emissions are subject to emissions in restricted bands only . The applicable frequencies, through ten harmonis, are given below in Table 4.1. Emission limits from digital circuitry are specified in Table 4.2.

Table 4.1. Radiated Emission Limits— Transmitter.

Frequency (MHz)	Fundamental Ave. E_{lim} (3m)		Spurious* Ave. E_{lim} (3m)	
	(μV/m)	dB (μV/m)	(μV/m)	dB (μV/m)
2400-2483.5	---		---	
2483.5-2500 4500-5250 7250-7750	Restricted Bands		500	54.0
14470-14500 17700-21400 22010-23120 23600-24000	Restricted Bands		500	54.0

* Measure up to tenth harmonic; 1 MHz res. BW, 100 Hz video BW (for average detection)

Table 4.2 Radiated Emission Limits (15.109) — Digital device.

Frequency	Class A ds = 10 m		Class B ds = 3 m	
(MHz)	(μV/m)	dB (μV/m)	(μV/m)	dB (μV/m)
30-88	90	39.0	100	40.0
88-216	150	43.5	150	43.5
219-960	210	46.4	200	46.0
960-	300	49.5	500	54.0

120 kHz BW up to 1 GHz, 1 MHz BW above 1 GHz

4.2 Conductive Emission Limits

Table 4.3. Conducted Emission Limits (15.107).

Frequency	Class A ds = 10 m		Class B ds = 3 m	
(MHz)	μV	dBμV	μV	dBμV
0.45-1.705	1000	60.0	250	48.0
1.705-30.0	3000	69.6	250	48.0

Note: Quasi-Peak readings apply here (9 kHz BW)

Class A limits apply to the DUT.

5. Radiated Emission Tests and Results

5.1 Anechonic Chamber Measurements

In our chamber there is a set-up similar to that of an outdoor 3-meter site, with a turntable, an antenna mast, and a ground plane. Instrumentation includes spectrum analyzers and other equipment as needed. For these tests the receicer (horn) antennas were placed on a styrofoam block, at about 1.2 m hight, and the DUT on a turntable, at 3 meter distance, then moved to 1 m distance.

Standard gain horn antennas were used for measurements. Up to 7 GHz the horns were connected to a spectrum analyzer via RG-214 coaxial cable, and above 7 GHz a pre-amp was added. The cables and the pre-amplifier used were specially calibrated for these tests using a network analyzer.

For each possible DUT antenna situation, the antenna was rotated in all possible ways and the maximum emission recorded. Except at 2483.5 MHz, in all other cases only noise was observed. A photograph in Figure 5.1 shows the measurement set-up.

5.2 Outdoor Measurements

None made

5.3 Computations and Results

To convert the dBm measured on the spectrum analyzer to dB(μV/m), we use expression

$$E_3(dB\mu V/m) = 107 + P_R + K_A - K_G + K_E$$

where
- P_R = power recorded on spectrum analyzer, dB, measured at 3m
- K_A = antenna factor, dB/m
- K_G = pre-amplifier gain, including cable loss, dB
- K_E = pulse operation correction factor, dB

When presenting the data, at each frequency the dominant measured emissions under all of the possible situations are given. Computations and results are given in Tables 5.1 through 5.3. There we see that in the worst case the DUT meets the limit by 4.1 dB at 2483.5 MHz.

5.4 Conducted Emission Tests

Were not measured. The case the card was tested has been Class A verified previous.

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Table 5.1 Highest Emissions Measured

Radiated Emissions											C-Spec RF Link w/ amplifier
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr** dBm	Det.* Used	Ka dB/m	Kg dB	E3 dBµV/m	E3lim dBµV/m	Pass dB	Comments
	Ant. #200A801; with 25 ft cable										
1	2483.5	HornS	H/V	-80.4	Ave	21.5	0.0	48.1	54.0	5.9	real signal, meas. at 3 m
2	4884.0	HornC	H/V	-82.5	Ave	25.5	0.0	40.5	54.0	13.5	noise floor, meas. at 1 m
3	7326.0	HornXN	H/V	-78.0	Ave	25.0	0.0	44.5	54.0	9.5	noise floor, meas. at 1 m
4	14500.0	HornKu	H/V	-71.6	Ave	30.9	17.3	39.5	54.0	14.5	noise floor, meas. at 1 m
5	19536.0	HornK	H/V	-69.7	Ave	32.3	32.0	28.1	54.0	25.9	noise floor, meas. at 1 m
6	21978.0	HornK	H/V	-66.2	Ave	32.8	32.5	31.6	54.0	22.4	noise floor, meas. at 1 m
	Ant. #200A901; with 25 ft cable										
1	2483.5	HornS	H/V	-80.3	Ave	21.5	0.0	48.2	54.0	**5.8**	real signal, meas. at 3 m
2	4884.0	HornC	H/V	-82.5	Ave	25.5	0.0	40.5	54.0	13.5	noise floor, meas. at 1 m
3	7326.0	HornXN	H/V	-78.0	Ave	25.0	0.0	44.5	54.0	9.5	noise floor, meas. at 1 m
4	14500.0	HornKu	H/V	-71.6	Ave	30.9	17.3	39.5	54.0	14.5	noise floor, meas. at 1 m
5	19536.0	HornK	H/V	-69.7	Ave	32.3	32.0	28.1	54.0	25.9	noise floor, meas. at 1 m
6	21978.0	HornK	H/V	-66.2	Ave	32.8	32.5	31.6	54.0	22.4	noise floor, meas. at 1 m
	Ant. #2426AA; with 25 ft cable										
1	2483.5	HornS	H/V	-80.7	Ave	21.5	0.0	47.8	54.0	6.2	real signal, meas. at 3 m
2	4884.0	HornC	H/V	-82.5	Ave	25.5	0.0	40.5	54.0	13.5	noise floor, meas. at 1 m
3	7326.0	HornXN	H/V	-78.0	Ave	25.0	0.0	44.5	54.0	9.5	noise floor, meas. at 1 m
4	14500.0	HornKu	H/V	-71.6	Ave	30.9	17.3	39.5	54.0	14.5	noise floor, meas. at 1 m
5	19536.0	HornK	H/V	-69.7	Ave	32.3	32.0	28.1	54.0	25.9	noise floor, meas. at 1 m
6	21978.0	HornK	H/V	-66.2	Ave	32.8	32.5	31.6	54.0	22.4	noise floor, meas. at 1 m
	* Ave: measured with 1 MHz Res BW and 100 Hz Video BW										

	Conducted Emissions						
	Freq. MHz	Line Side	Det. Used	Vtest dBµV	Vlim dBuV	Pass dB	Comments
1							
2		Not applicable					
10							

Table 5.2 Highest Emissions Measured

Radiated Emissions											C-Spec RF Link w/ amplifier
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr** dBm	Det.* Used	Ka dB/m	Kg dB	E3 dBµV/m	E3lim dBµV/m	Pass dB	Comments
	Ant. #A02-12; with 25 ft cable										
1	2483.5	HornS	H/V	-80.2	Ave	21.5	0.0	48.3	54.0	5.7	real signal, meas. at 3 m
2	4884.0	HornC	H/V	-82.5	Ave	25.5	0.0	40.5	54.0	13.5	noise floor, meas. at 1 m
3	7326.0	HornXN	H/V	-78.0	Ave	25.0	0.0	44.5	54.0	9.5	noise floor, meas. at 1 m
4	14500.0	HornKu	H/V	-71.6	Ave	30.9	17.3	39.5	54.0	14.5	noise floor, meas. at 1 m
5	19536.0	HornK	H/V	-69.7	Ave	32.3	32.0	28.1	54.0	25.9	noise floor, meas. at 1 m
6	21978.0	HornK	H/V	-66.2	Ave	32.8	32.5	31.6	54.0	22.4	noise floor, meas. at 1 m
	Ant. #2415AB; with 50 ft cable										
1	2483.5	HornS	H/V	-78.6	Ave	21.5	0.0	49.9	54.0	**4.1**	real signal, meas. at 3 m
2	4884.0	HornC	H/V	-82.5	Ave	25.5	0.0	40.5	54.0	13.5	noise floor, meas. at 1 m
3	7326.0	HornXN	H/V	-78.0	Ave	25.0	0.0	44.5	54.0	9.5	noise floor, meas. at 1 m
4	14500.0	HornKu	H/V	-71.6	Ave	30.9	17.3	39.5	54.0	14.5	noise floor, meas. at 1 m
5	19536.0	HornK	H/V	-69.7	Ave	32.3	32.0	28.1	54.0	25.9	noise floor, meas. at 1 m
6	21978.0	HornK	H/V	-66.2	Ave	32.8	32.5	31.6	54.0	22.4	noise floor, meas. at 1 m
	Ant. #ANT2HU801; with 10 ft RG-58 cable										
1	2483.5	HornS	H/V	-79.6	Ave	21.5	0.0	48.9	54.0	5.1	real signal, meas. at 3 m
2	4884.0	HornC	H/V	-82.5	Ave	25.5	0.0	40.5	54.0	13.5	noise floor, meas. at 1 m
3	7326.0	HornXN	H/V	-78.0	Ave	25.0	0.0	44.5	54.0	9.5	noise floor, meas. at 1 m
4	14500.0	HornKu	H/V	-71.6	Ave	30.9	17.3	39.5	54.0	14.5	noise floor, meas. at 1 m
5	19536.0	HornK	H/V	-69.7	Ave	32.3	32.0	28.1	54.0	25.9	noise floor, meas. at 1 m
6	21978.0	HornK	H/V	-66.2	Ave	32.8	32.5	31.6	54.0	22.4	noise floor, meas. at 1 m
		* Ave: measured with 1 MHz Res BW and 100 Hz Video BW									

	Conducted Emissions						
	Freq. MHz	Line Side	Det. Used	Vtest dBµV	Vlim dBuV	Pass dB	Comments
1							
2		Not applicable					
10							

Table 5.3 Highest Emissions Measured

Radiated Emissions											C-Spec RF Link w/ amplifier
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr** dBm	Det.* Used	Ka dB/m	Kg dB	E3 dBµV/m	E3lim dBµV/m	Pass dB	Comments
	Ant. #2CON1001; with 25 ft cable										
1	2483.5	HornS	H/V	-81.3	Ave	21.5	0.0	47.2	54.0	6.8	real signal, meas. at 3 m
2	4884.0	HornC	H/V	-82.5	Ave	25.5	0.0	40.5	54.0	13.5	noise floor, meas. at 1 m
3	7326.0	HornXN	H/V	-78.0	Ave	25.0	0.0	44.5	54.0	9.5	noise floor, meas. at 1 m
4	14500.0	HornKu	H/V	-71.6	Ave	30.9	17.3	39.5	54.0	14.5	noise floor, meas. at 1 m
5	19536.0	HornK	H/V	-69.7	Ave	32.3	32.0	28.1	54.0	25.9	noise floor, meas. at 1 m
6	21978.0	HornK	H/V	-66.2	Ave	32.8	32.5	31.6	54.0	22.4	noise floor, meas. at 1 m
	Ant. #2CON1701; with 3 dB attenuator and 50 ft cable										
1	2483.5	HornS	H/V	-80.1	Ave	21.5	0.0	48.4	54.0	**5.6**	real signal, meas. at 3 m
2	4884.0	HornC	H/V	-82.5	Ave	25.5	0.0	40.5	54.0	13.5	noise floor, meas. at 1 m
3	7326.0	HornXN	H/V	-78.0	Ave	25.0	0.0	44.5	54.0	9.5	noise floor, meas. at 1 m
4	14500.0	HornKu	H/V	-71.6	Ave	30.9	17.3	39.5	54.0	14.5	noise floor, meas. at 1 m
5	19536.0	HornK	H/V	-69.7	Ave	32.3	32.0	28.1	54.0	25.9	noise floor, meas. at 1 m
6	21978.0	HornK	H/V	-66.2	Ave	32.8	32.5	31.6	54.0	22.4	noise floor, meas. at 1 m
	Ant. #2CON2301; with 10 dB attenuator and 50 ft cable										
1	2483.5	HornS	H/V	-80.2	Ave	21.5	0.0	48.3	54.0	5.7	real signal, meas. at 3 m
2	4884.0	HornC	H/V	-82.5	Ave	25.5	0.0	40.5	54.0	13.5	noise floor, meas. at 1 m
3	7326.0	HornXN	H/V	-78.0	Ave	25.0	0.0	44.5	54.0	9.5	noise floor, meas. at 1 m
4	14500.0	HornKu	H/V	-71.6	Ave	30.9	17.3	39.5	54.0	14.5	noise floor, meas. at 1 m
5	19536.0	HornK	H/V	-69.7	Ave	32.3	32.0	28.1	54.0	25.9	noise floor, meas. at 1 m
6	21978.0	HornK	H/V	-66.2	Ave	32.8	32.5	31.6	54.0	22.4	noise floor, meas. at 1 m
		* Ave: measured with 1 MHz Res BW and 100 Hz Video BW									

	Conducted Emissions						
	Freq. MHz	Line Side	Det. Used	Vtest dBµV	Vlim dBuV	Pass dB	Comments
1							
2		Not applicable					
10							

OTHER DATA

Since the RF-2A uses an (added) external amplifier to increase the performance of the system, the following additional measurements were performed and results are presented in subsequent pages. Here we are somewhat embarrassed to say that we do not have the plots we recorded on October 9, 1997.

On that day measurements were made and plots recorded for two C-Spec products,

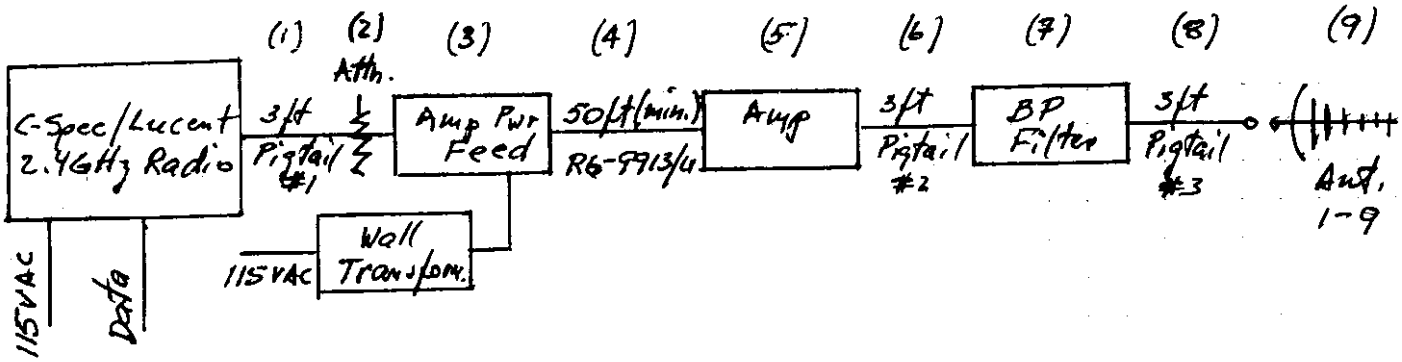
RF-2A FCC ID: MBX-OLANWB2A (being applied for here)
RF-10A FCC ID: MBX-OLANWB10A

The RF-10A (also with an external amplifier) has been applied for certification previous and was evaluated by Joe Dichoso. That application did include the plots. However, as for the RF-2A, the plots were lost. (At best, we recall they were placed near the waste basket area and were gone by the next day.) Luckily, we already had extracted the pertinent data and those are presented here.

To show how the data was recorded, we show here sample measurements from RF-10A. For the subject device, the RF-2A, the measurements were made for the lowest (2412 MHz), mid (2442 MHz), and highest (2462 MHz) channels.

POWER BUDGET: C-Spec RF-2A

Block Diagram



#	Antenna Model(s)	Ant. Gain dBi	Connection Configuration	RF Pwr at Ant. dBm	EIRP dBm	R* for 1mW/cm²
1	200A8Φ1 2ΦΦA8Φ1	8.2	(1), (3)-(9)	21.1	29.3	0.08m
2	2DB8AΦ1 2ΦΦA9Φ1	8.1	—"—	21.1	29.2	0.08m
3	2426AA 2TELA5Φ1	5.0	—"—	21.1	26.1	0.05m
4	200A12Φ1 A02-12	12.4	—"—	21.1	33.5	0.13m
5	2TEL13Φ1 2415AB	13.5	—"—	21.1	34.6	0.14m
6	ANT2H4B01	8.5	—"—	21.1	29.6	0.08m
7	2CON1ΦΦ1	10.0	—"—	21.1	31.1	0.11m
8	2CON17Φ1	17.0	(1)-(9); (2): 3dB	18.1 Δ	35.1	0.16m
9	2CON23Φ1	23.0	(1)-(9); (2): 10dB	11.1 Δ	34.1	0.14m

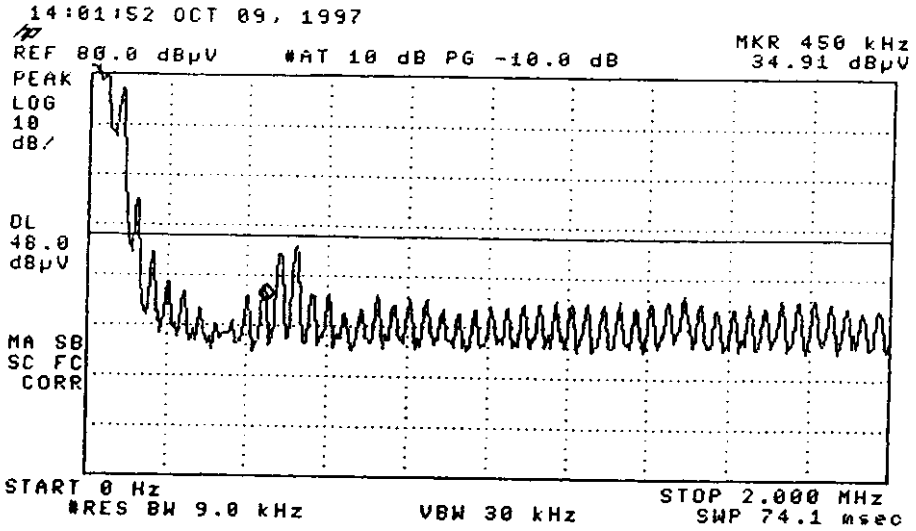
Δ estimated

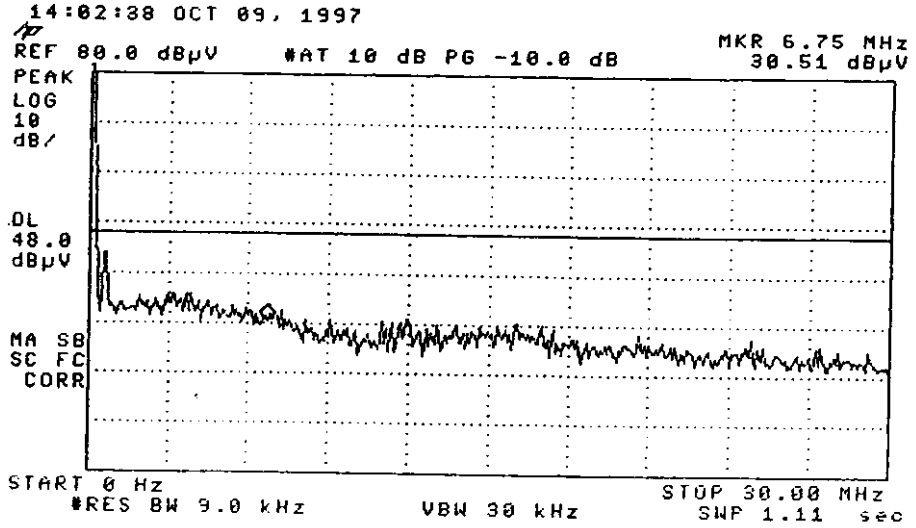
* R based on far-field formula.
$R(m) = 0.00282\sqrt{P(mW)}$

EXHIBIT F

U of Michigan file 415031-869

SAMPLE MEASUREMENT FROM C-SPEC RF-10A
(FCC ID: MBX-OLANWB10A)





Amplifier Line
Conducted (Hi side)

EXHIBIT F

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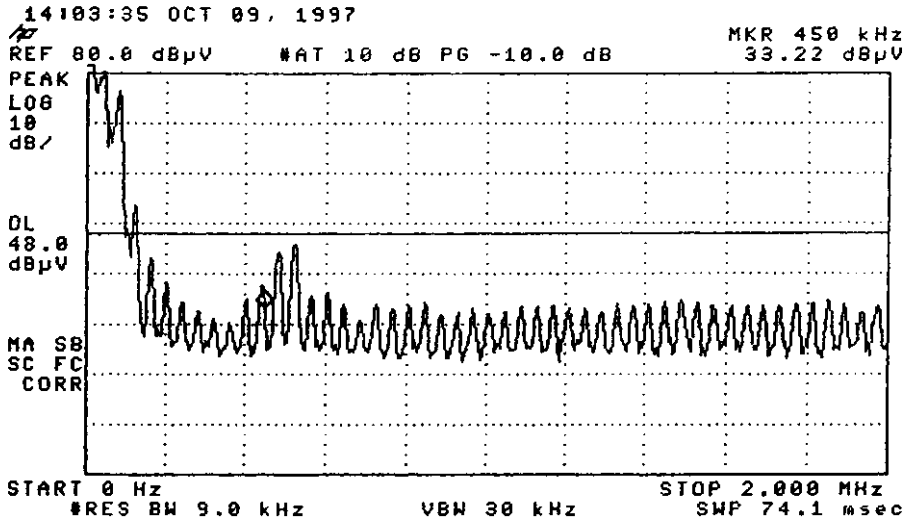
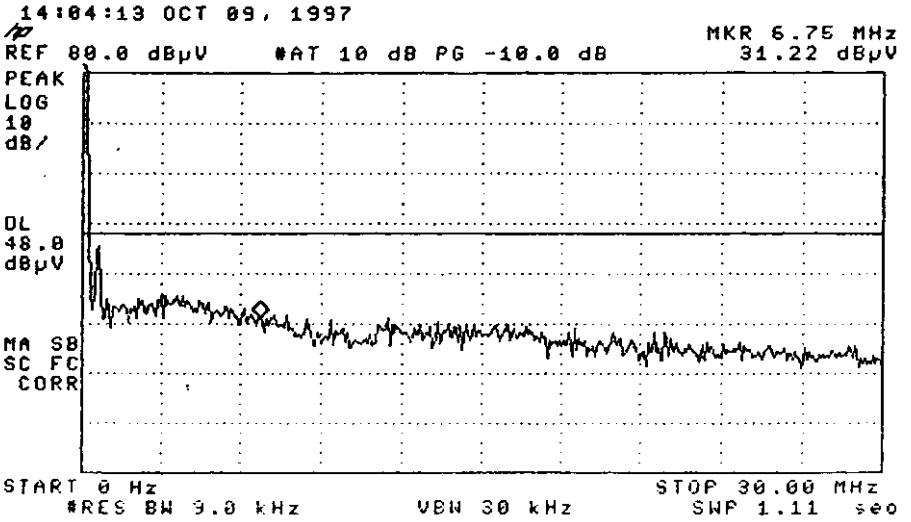
SAMPLE MEASUREMENT FROM C-SPEC RF-10A
(FCC ID: MBX-OLANWB10A)





Amplifier Line
Conducted (Lo side)

EXHIBIT F
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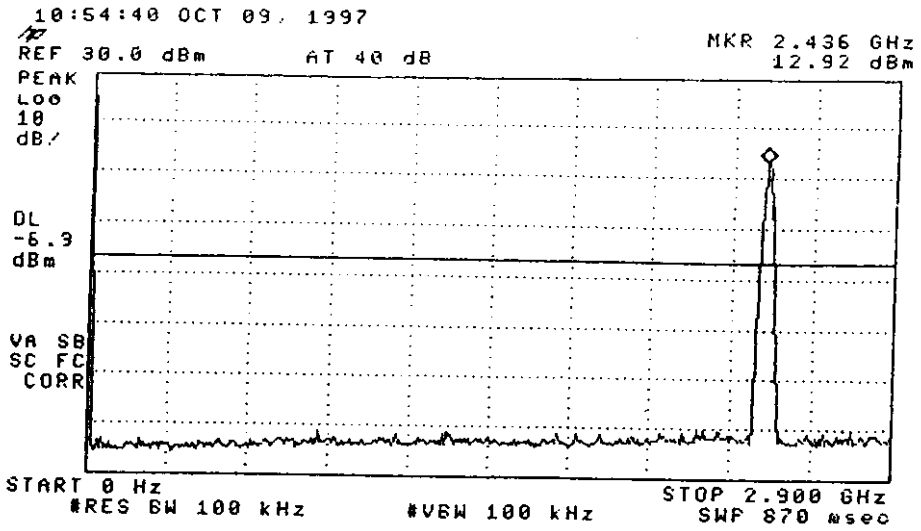
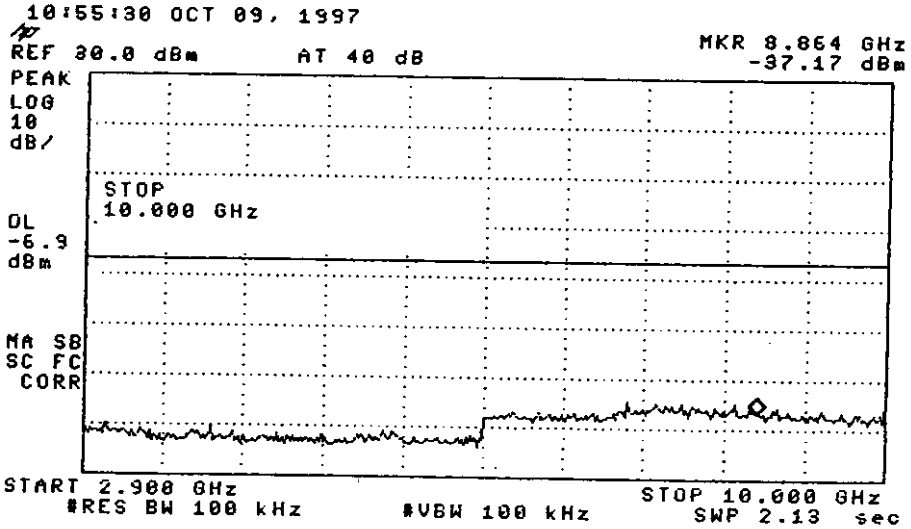
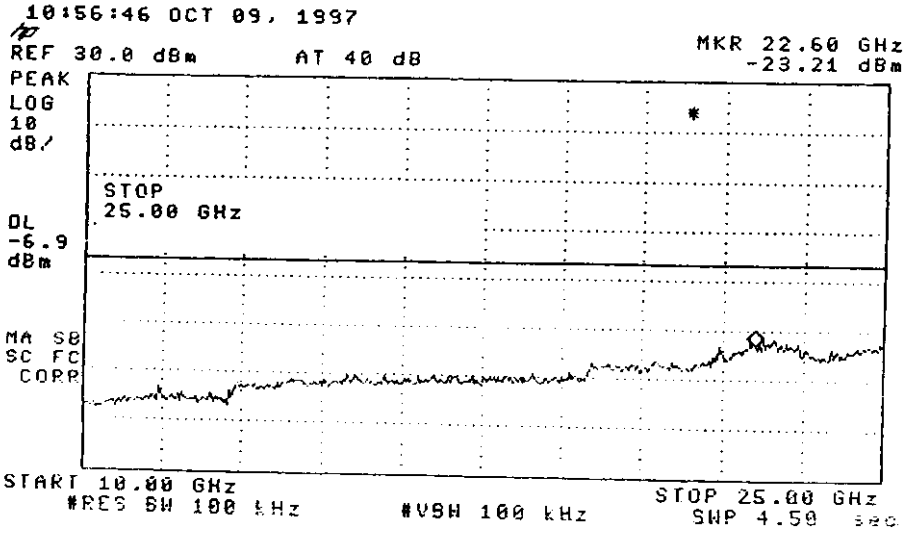
SAMPLE MEASUREMENT FROM C-SPEC RF-10A
(FCC ID: MBX-OLANWB10A)







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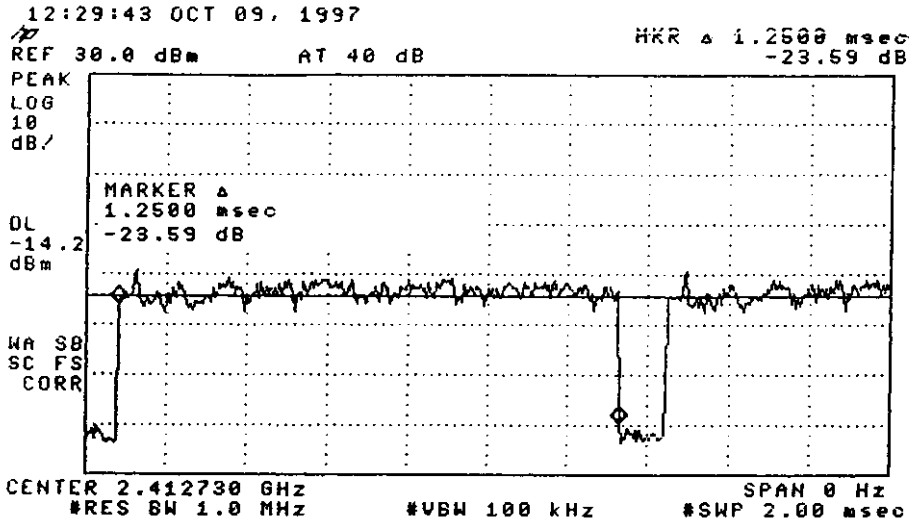
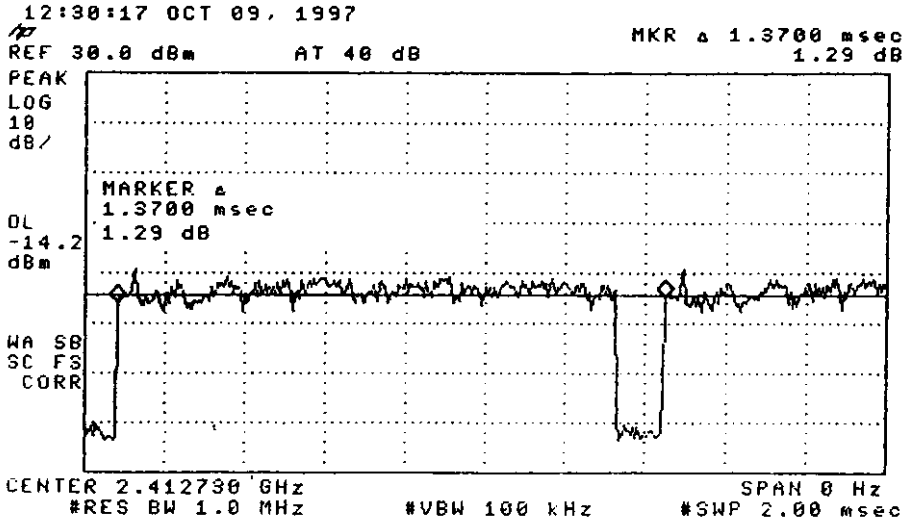
Antenna Conducted
Emissions

SAMPLE MEASUREMENT FROM C-SPEC RF-10A
(FCC ID: MBX-OLANWB10A)





Duty Factor

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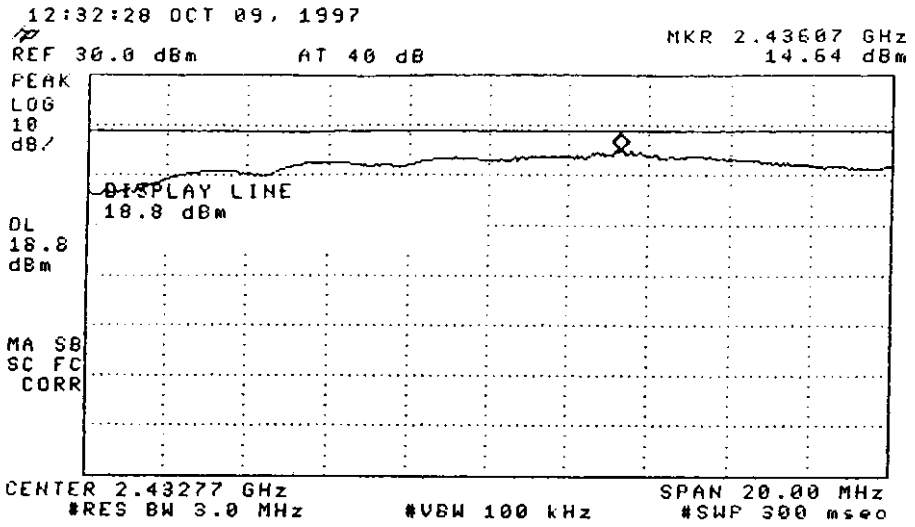
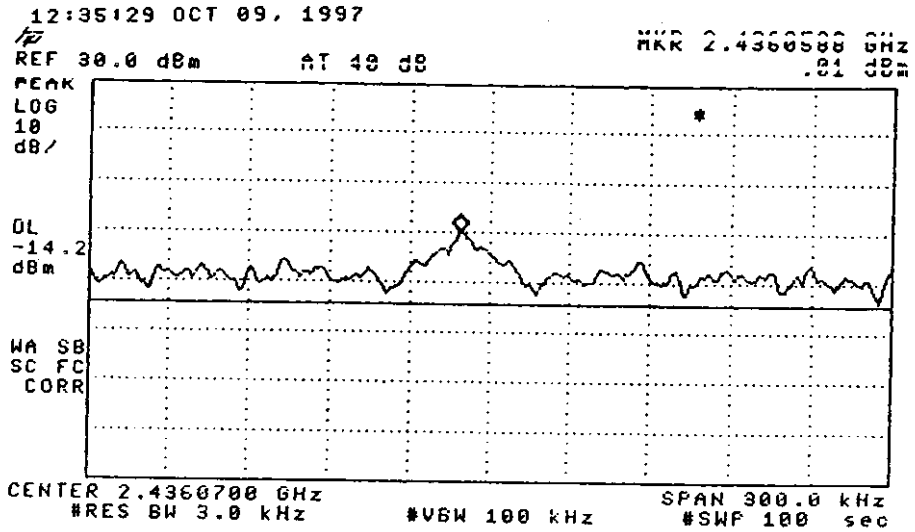
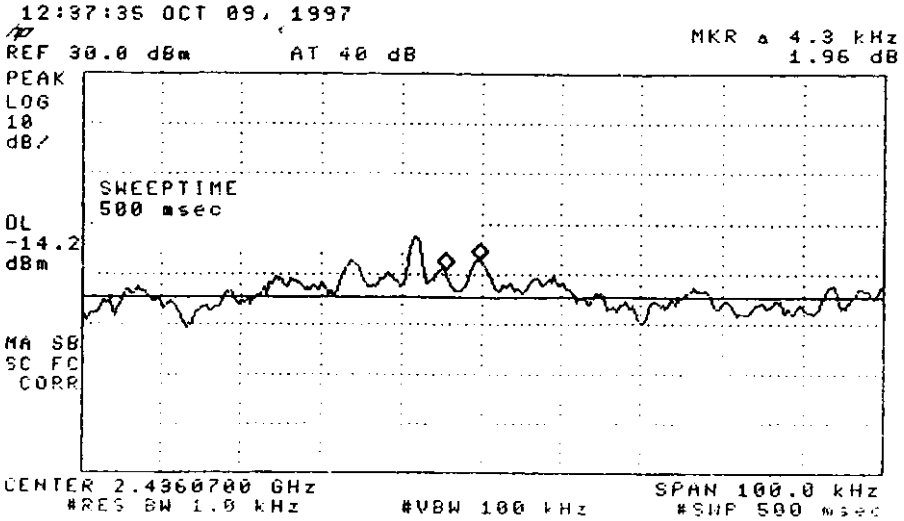
SAMPLE MEASUREMENT FROM C-SPEC RF-10A
(FCC ID: MBX-OLANWB10A)



Maximun Spectrum is
at 2.43607 Mhz



Scan for (Max)
Spectral Density



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Measurement of
Spectral Lines

Power Line Conducted Emissions (15.207)

The RF amplifier that goes at the antenna is powered through the RF cable, which in turn, is powered from a switching power supply via bias Tee. The worst case conducted emissions were 45.0 dBμv (peak) at 0.52 MHz.

Conducted emissions from the PC were not measured since that is already Class A compliant.

(Limit 48 dBμV, QP)

Bandwidth (15.247(a)(2).

For this, the DUT was put in a test mode for continuous data transmission. With spectrum analyzer connected at the antenna connector, for each of the three channels tested the spectrum analyzer was set for RBW=100 kHz, VBW=300 kHz, and SPAN= 100 MHz. The 6 dB bandwidth values obtained were:

Frequency Channel	6 dB Bandwidth
2.412 GHz	11.4 MHz
2.442 GHz	12.2 MHz
2.462 GHz	10.3 MHz

Maximum Peak Output Power (15.247(b))

For this, the DUT was put in a continuous transmit mode and the power was measured at the antenna terminals with a bolometer type microwave power meter. The system consisted of the RF bridge, pigtail cable, lightening arrestor, and 50 ft RG-9913/U cable. There was, however, still a -0.6 dB duty factor, and for such, the meter reading was increased by 0.6 dB. Measurements were made at the lowest, mid, and highest channels.

Frequency	Meter Reading	Adjusted Value
2.412 GHz	16.0 dBm	16.8 dBm
2.442 GHz	20.5 dBm	21.1 dBm
2.462 GHz	11.0 dBm	11.8 dBm

(Limit 30 dBm)

RF Antenna Conducted Spurious Emissions (15.247(c))

For this, the DUT was put in a continuous transmit mode and the (cable) antenna connector was connected directly to the spectrum analyzer. With RBW=VBW=100 kHz, the frequency was swept from 0 to 25 GHz. Sweeps were made for lowest, mid, and highest frequency channels. In all three cases only the fundamental was seen, and the worst case was a noise measurement of -28.5 dB below the carrier at 21.0 GHz. (Limit -20.0 dB below carrier)

Power Spectral Density (15.247(d))

For this, the DUT was put in a test mode for continuous data transmission. With spectrum analyzer connected at the antenna connector, each of the three channels tested were first scanned for the maximum spectrum peaks and then at these peaks the sweep was repeated with RBW=3 kHz, VBW=100 kHz, SPAN=300 kHz, and SWEEP TIME=100s. The maximum readings obtained were:

Frequency Channel	Meter Reading
2.412 GHz	1.3 dBm
2.442 GHz	1.8 dBm
2.462 GHz	0.5 dBm

(Limit 8.0 dBm)

The spectrum line spacing was 7.5 kHz.