125 Technology Parkway
Norcross, Georgia, US 30092

Frequency Hopping Spread Spectrum Transmitter

Manufacturer: LXE Inc.

Model: 480824-3300

FCC ID: KDZ4808243300M

Scope of Testing: FCC Part 15, Subpart C
Section/Standard: 47 CFR § 15.247

Issue Date: April 26, 1999

Table of Contents

1.0 GENERAL

1.1 Introduction

The purpose of this report is to demonstrate compliance with Part 15, Subpart C of the FCC's Code of Federal Regulations. Testing was performed by LXE Inc., a division of EMS Technologies, Inc.

1.2 Product Description

The equipment under test(EUT) is the combination of the Huber & Suhner antenna type 9090.16.0001 and the LXE Transceiver model 480824-3300.

The antenna has a gain of 1.8dBi and is designed for 2.4 GHz operation. It is primarily used with radios installed in LXE Hand Held Computer Terminals (HHT). The antenna couples to the radio via a custom designed connector satisfying the requirements of section **15.203** of the FCC rules.

The transceiver is a Frequency Hopping Spread Spectrum radio that operates in the band of 2.400-2.4835 GHz at a nominal 100mW. The radio is currently approved by the commission under FCC ID: KDZ480824-3300M, via a private label agreement with Proxim Inc. In May of 1997, LXE filed a Change of Identification application with the FCC to Proxim Inc.'s. FCC ID: IMKRL21PC. A grant of this application was made October 14, 1997.

The combination of the radio, antenna and a suitable host are used in establishing wireless LAN's for applications such as inventory tracking, healthcare and office settings. The radio can only be used in host devices that are equipped with a type 2 PCMCIA interface and the proper software for operation. Selected hosts must be compliant to FCC Part 15, Subpart B rules and regulations among others.

2.0 LOCATION OF TEST FACILITY

The LXE test facility is located at the following address:

LXE, Inc.
An Electromagnetic Sciences Company
125 Technology Parkway
Norcross, GA US 30092-2993
Tel: (770) 447-4224
Fax: (770) 447-6928

Radiated emission tests were conducted at the manufacture's test facility at a location specifically prepared for this testing. The radiated emissions test site meets the characteristics of ANSI C63.4:1992, CISPR 16 and EN 55022:1994. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT, 1300F2.

3.0 DESCRIPTION OF OPEN AREA TEST SITE

The open area test site(OATS) is located in the center of the rooftop of the building. The roof is located at a height of approximately 8 meters above the ground. The 3 meters radiated emissions test site is an open, flat area (open area) test site approximately 6.2m x 9.2m in dimension. All reflecting objects including test personnel lie outside the perimeter of the ellipse. The 3 meters test site ground plane is made of a 1/4" metal screen mesh which extends 2 meters past the mast and equipment under test(EUT). Material of the ground plane, comprised of individual 1/4" metal screen mesh rolls, were soldered at the seams with gaps smaller than 1/10 of the wavelength at 1000MHz. The ground plane is connected to the earth ground by ground rods. All wiring is done at floor level around the test site periphery. The radiated emissions test setup is shown in figure 1.

3.1 Radiated Emissions Testing Facility Drawing

All dimensions are in meters(m)

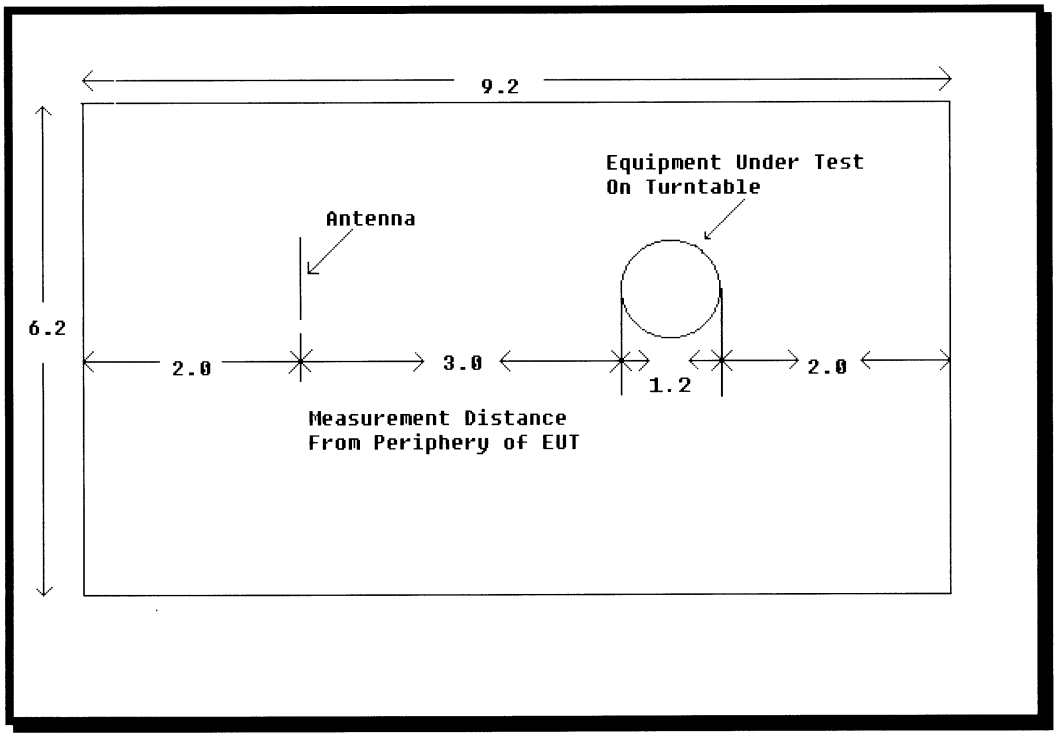


Figure 1: Open Area Test Site(OATS)

4.0 APPLICABLE STANDARD REFERENCES

The following standards were used for this test:

1 - ANSI C63.4-1992: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz

2 - US Code of Federal Regulations (CRF): Title 47, Part 15, Radio Frequency Devices, Subpart C, Intentional Radiators (October 1997)

5.0 LIST OF TEST EQUIPMENT

Radiated field strength measurements are taken with a spectrum analyzer. For peak measurements the spectrum analyzer was set with both the VBW and the RBW at 1MHz. Average measurements were taken with the RBW at 1MHz and the VBW at 10Hz. The sweep rate was set to auto to optimize the measurement. Adequate attenuation was used to protect the analyzer from damage.

Table 1: Test and Support Equipment

Description	Manufacturer	Model/Part #	Serial #	Calibration Due Date
Spectrum Analyzer	Hewlett Packard	HP 8591A	3131A02254	05/04/99
Spectrum Analyzer	Hewlett Packard	HP 8563E	3304A00657	05/05/99
Preamplifier	LXE	20-1000 MHz	001	
Preamplifier	Hewlett Packard	83006A	3116A01317	10/05/99
HI-Pass Filter	MiniCircuits	SHP-1000		02/26/00
HI-Pass Filter	MicroWave Circuits	H3G020G2	0001	01/05/00
LISN	EMCO	3810/2NM	9505-1024	04/29/99
Biconical Antenna	EMCO	3104C	9012-4360	05/12/99
Biconical Antenna	Electro-Metric	BIA-25	1165	05/06/99
Log Periodic	EMCO	3146	3011-2946	04/01/00
Horn Antenna	ElectroMetric	RGA-60	6166	04/05/00
Horn Antenna	ElectroMetric	RGA-60	6165	08/20/99
Dipole Antenna Set	CDI	Roberts Dipole	265	04/03/00
RF Cable			NSN	10/05/99
RF Cable			7015	10/05/99
RF Cable			6986	10/05/99
Antenna Mast	CDI	CDI	N/A	N/A
Turntable	CDI	CDI	N/A	N/A
RF Enclosure	Lindgren Enclosure	14-2/2-0	8147	N/A

6.0 TEST METHODOLOGY

For the radiated emissions tests, measurements were made over the frequency range of 30MHz to 10 times the highest fundamental frequency. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test(EUT)and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. A nonconductive remotely controlled turntable approximately 0.91m x 1.2m x 0.8m was used to measure radiated emissions from all sides of the EUT. The turntable has a center opening that allows cabling to be routed directly down to the conducting ground plane.

Due to high ambient noise levels and small EUT size, radiated emission measurements may be made at a distance of 1 meter. An inverse proportionality factor of 20 dB per decade is used to normalize the measured data to the specified distance to determine compliance. The formula used to calculate an inverse proportionality factor is 20 log (D1/D2), where D1 is the distance used and D2 is the specified distance.

Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz for measurements above 30MHz and below 1000MHz, and 1MHz for measurements above 1000 MHz.

7.0 SUPPORT EQUIPMENT

Table 2: Support Equipment

Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
WinBook XP	LapTop Computer	ANL-4	10AUA01756	JRUANL-4M66
DELL	AC/DC Power Adapter	ADP-45GB	N6745067248	NONE

8.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

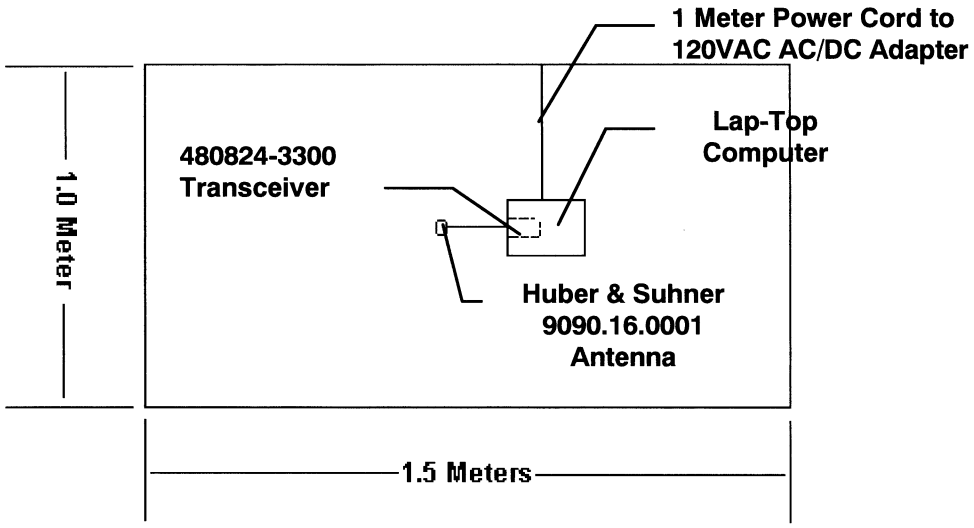


Figure 2: Test Setup Block Diagram

9.0 TEST SETUP PHOTOGRAPHS

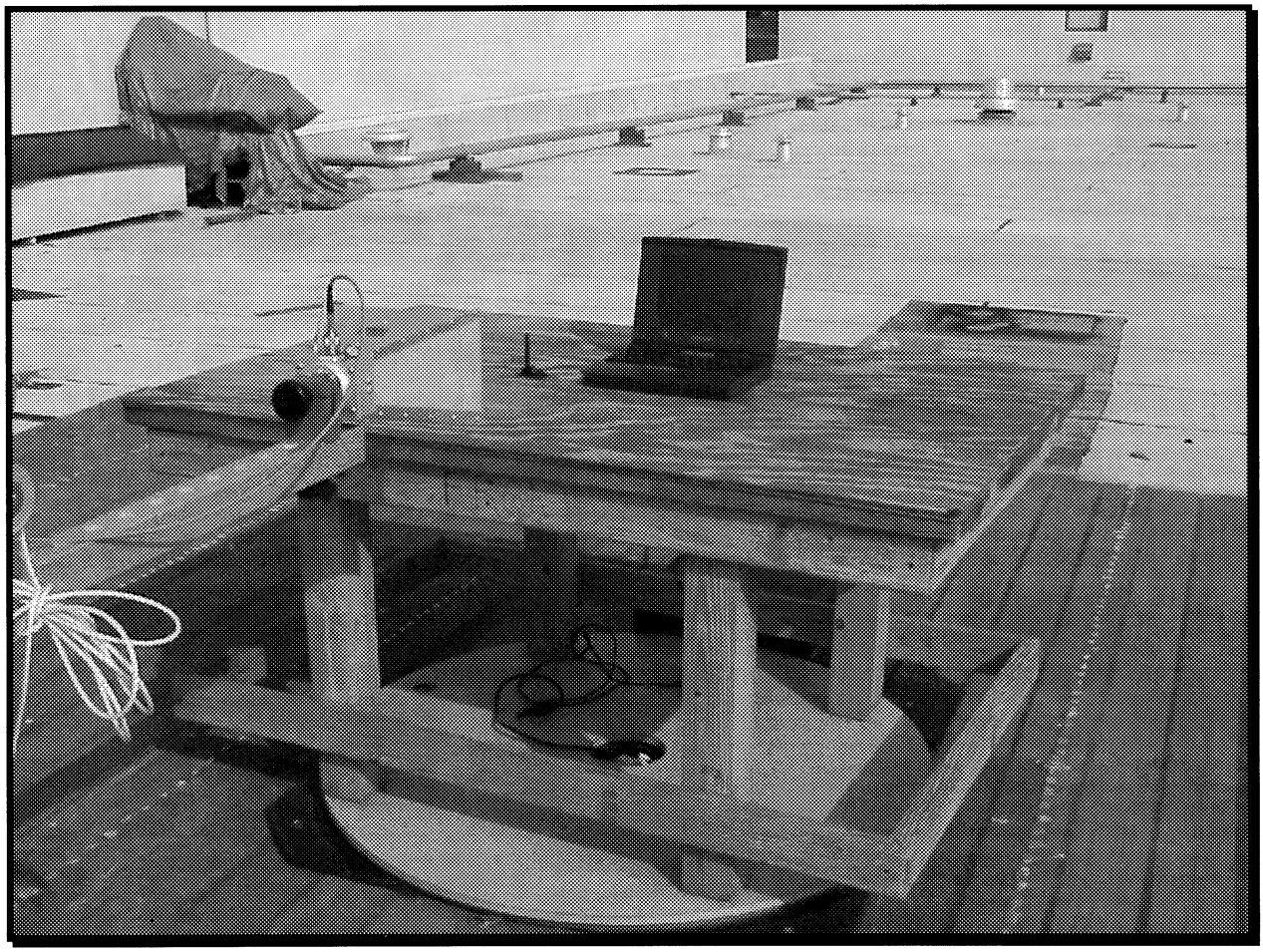


Figure 3: Front View

9.0 TEST SETUP PHOTOGRAPHS(cont.)

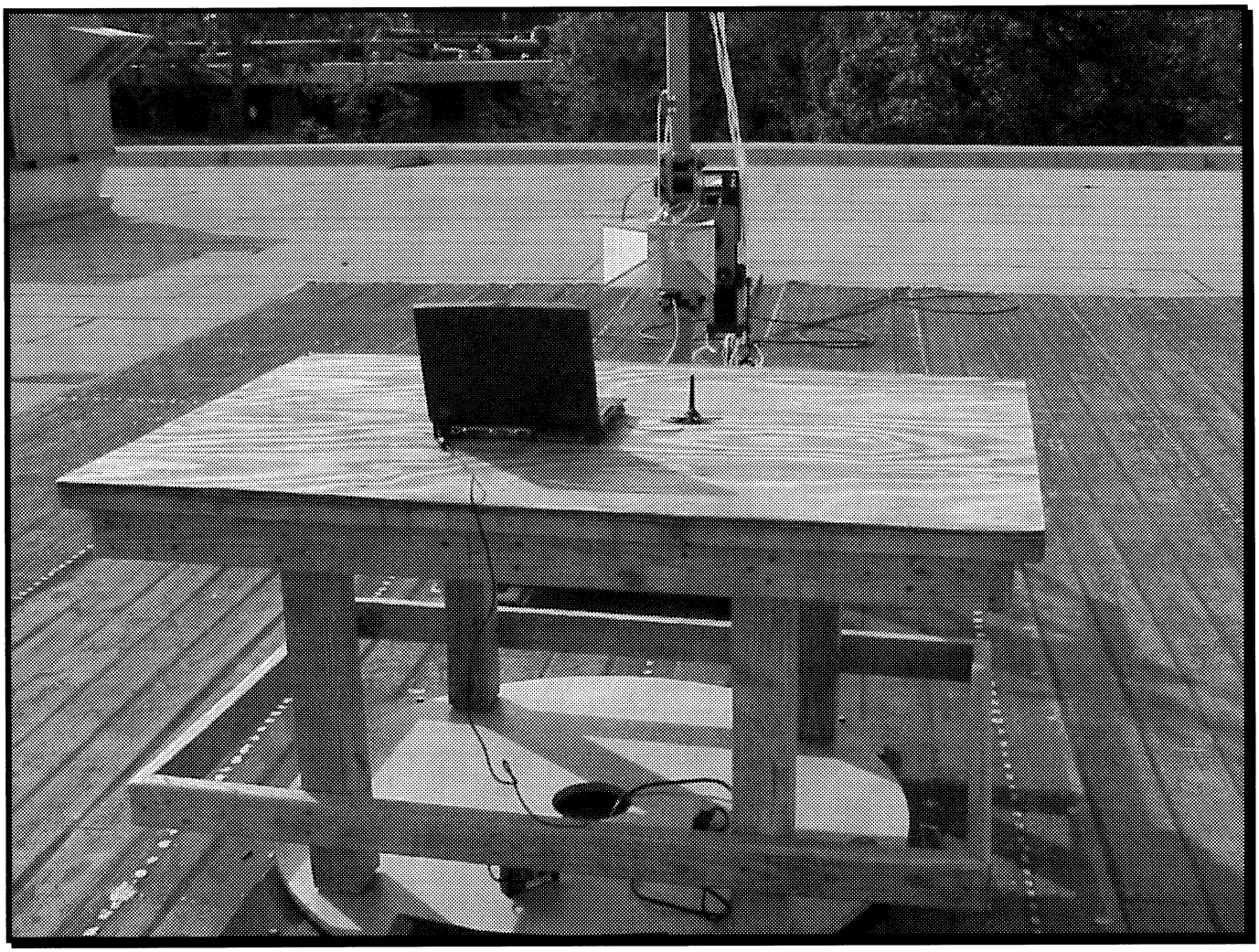


Figure 4: Back View

10.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were also taken of all signals deemed important enough to document. The tables below make reference to plot numbers that can be found following each section.

10.1 Antenna Requirement - FCC Section 15.203

The antenna is equipped with a unique and proprietary connector. Substitution of the antenna would require electrical modifications of the transceiver.

10.2 Band Utilization

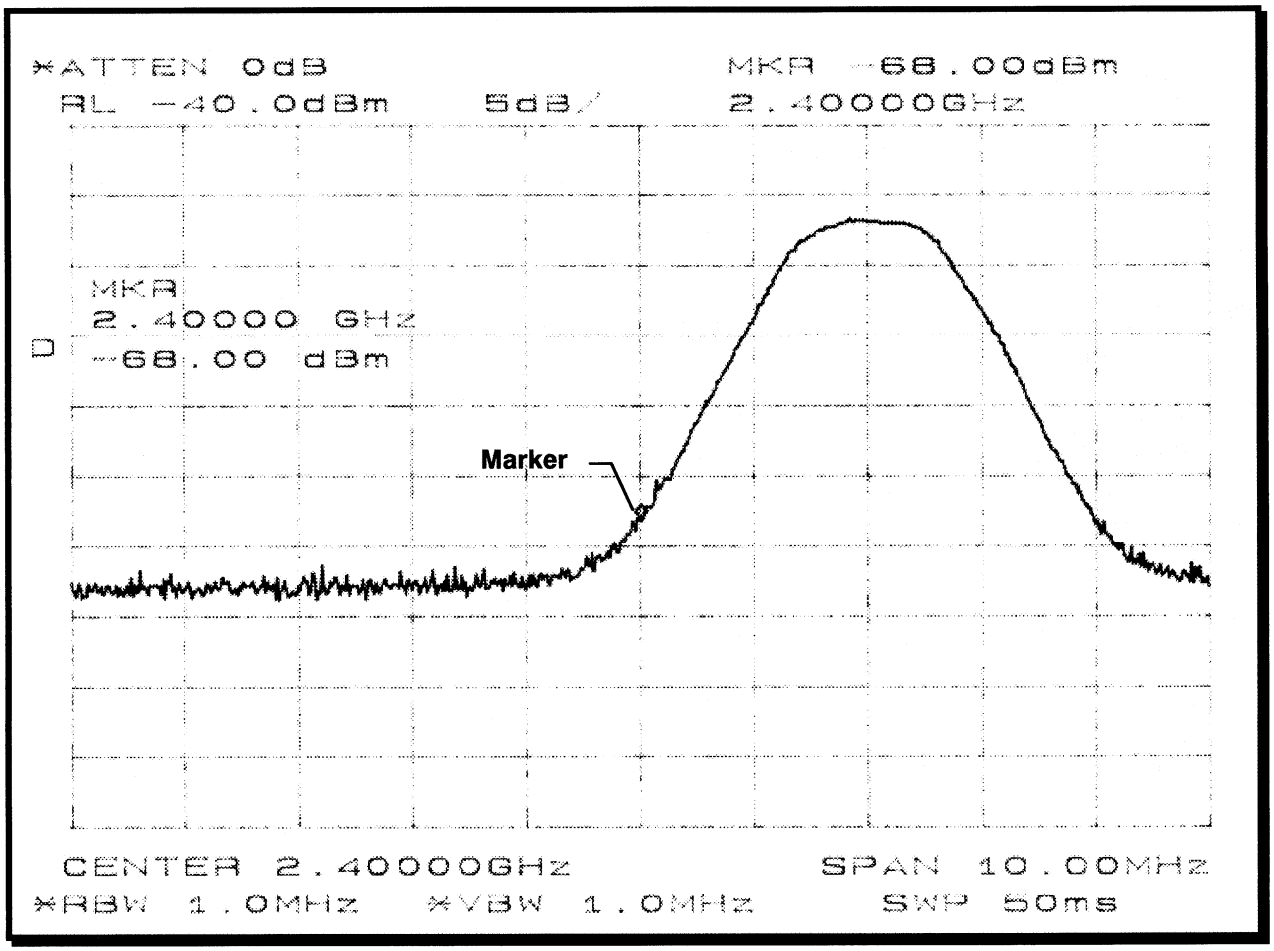


Figure 5: Lower Bandedge

10.2 Band Utilization(cont.)

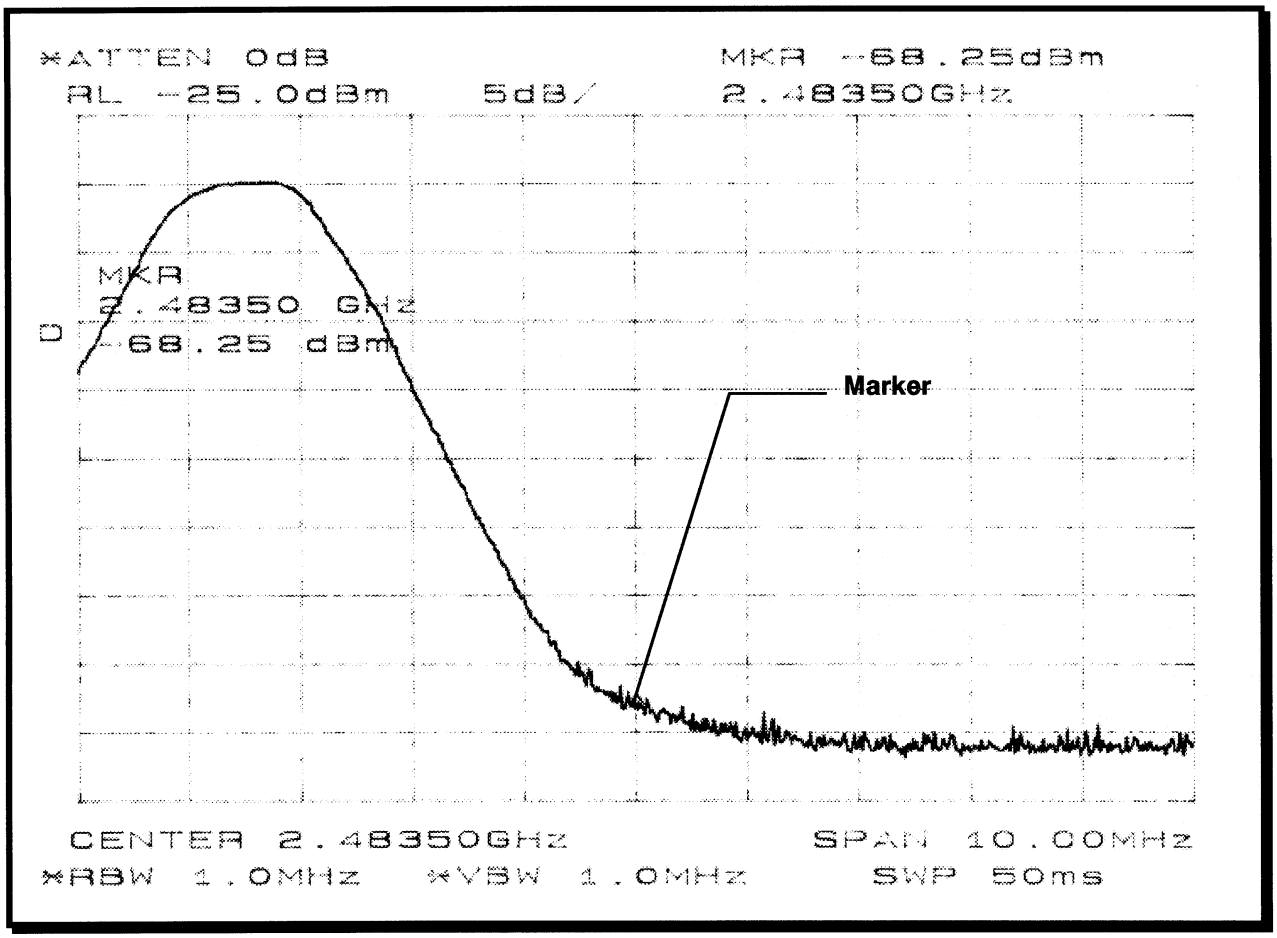


Figure 6: Upper Bandedge

10.3 Radiated Spurious Emissions(Restricted Bands)

Peak radiated spurious emissions found in the restricted bands are reported below in table 4. Average measurements are shown in table 5. Plots of this data were also taken and follow these tables.

Table 4: Radiated Spurious Emissions - Peak Measurements

Frequency (GHz)	Level** (dBm)	Correction Factors	Range Correction	Corrected Level(dBm)	Corrected Level(uV/m)	Limit (uV/m)	Margin (dB)	Pass/Fail
Low Channel								
4.804	-70.25	13.60	9.54	-66.19	109.77	5000	4890.220	Pass
7.205	-68.75	19.71	9.54	-58.58	263.30	5000	4736.367	Pass
9.608*	-73.9	21.46	9.54	-61.98	178.238	5000	4821.762	Pass
12.000*	-74.1	24.69	9.54	-58.95	252.639	5000	4747.361	Pass
Mid Channel								
4.884	-69.75	13.60	9.54	-65.69	116.28	5000	4883.721	Pass
7.326	-69.00	19.71	9.54	-58.83	256.153	5000	4743.847	Pass
9.760*	-73.8	21.46	9.54	-61.88	180.302	5000	4819.698	Pass
12.200*	-72.7	24.69	9.54	-57.55	296.825	5000	4703.175	Pass
High Channel								
4.960	-70.08	13.60	9.54	-66.02	111.944	5000	4888.056	Pass
7.440	-66.58	19.71	9.54	-56.41	338.454	5000	4661.546	Pass
9.919*	-73.50	21.46	9.54	-61.58	186.638	5000	4813.362	Pass
12.400*	-71.75	24.69	9.54	-56.60	331.131	5000	4668.869	Pass

* Measurement was of the noise floor and no plots taken.

** If emissions could not be detected at a distance of 3 meters. Antenna was moved up to one meter and corrected as indicated in the range correction column.

Correction Factors

Correction factors include the following:

Antenna Factors + Cable Attenuation + High Pass Filter Loss - Amp Gain

Duty cycle and range corrections are not included since they are not always used.

Range Correction = 20Log(D1/D2) Where D1 is the specified distance used and D2 is the distance used to make measurements = [20Log(3/1)] = 9.54 dB

Sample Calculations

Corrected Level(dBm) = Receiver Level + Correction Factors - Range Correction

Conversion from dBm to uV/m = Antilog(dBm + 107)/20)

10.3 Radiated Spurious Emissions(Restricted Bands)(cont.)

Table 5: Radiated Spurious Emissions - Average Measurements

Frequency (GHz)	Level (dBm)	Correction Factors	Range Correction	Corrected Level(dBm)	Corrected Level(uV/m)	Limit (uV/m)	Margin (uV/m)	Pass/Fail
ALL PEAK MEASUREMENTS MET THE AVERAGE LIMITS, THEREFORE AVERAGE MEASUREMENTS WERE DEEMED UNECESSARY								

Correction Factors

Correction factors include the following:

Antenna Factors + Cable Attenuation + High Pass Filter Loss - Amp Gain

Duty cycle and range corrections are not included since they are not always used.

Range Correction = 20Log(D1/D2) Where D1 is the specified distance used and D2 is the distance used to make measurements = [20Log(3/1)] = 9.54 dB

Sample Calculations

Corrected Level(dBm) = Receiver Level + Correction Factors - Range Correction

Conversion from dBm to uV/m = Antilog(dBm + 107)/20)

10.3 Radiated Spurious Emissions(Restricted Bands)(cont.)

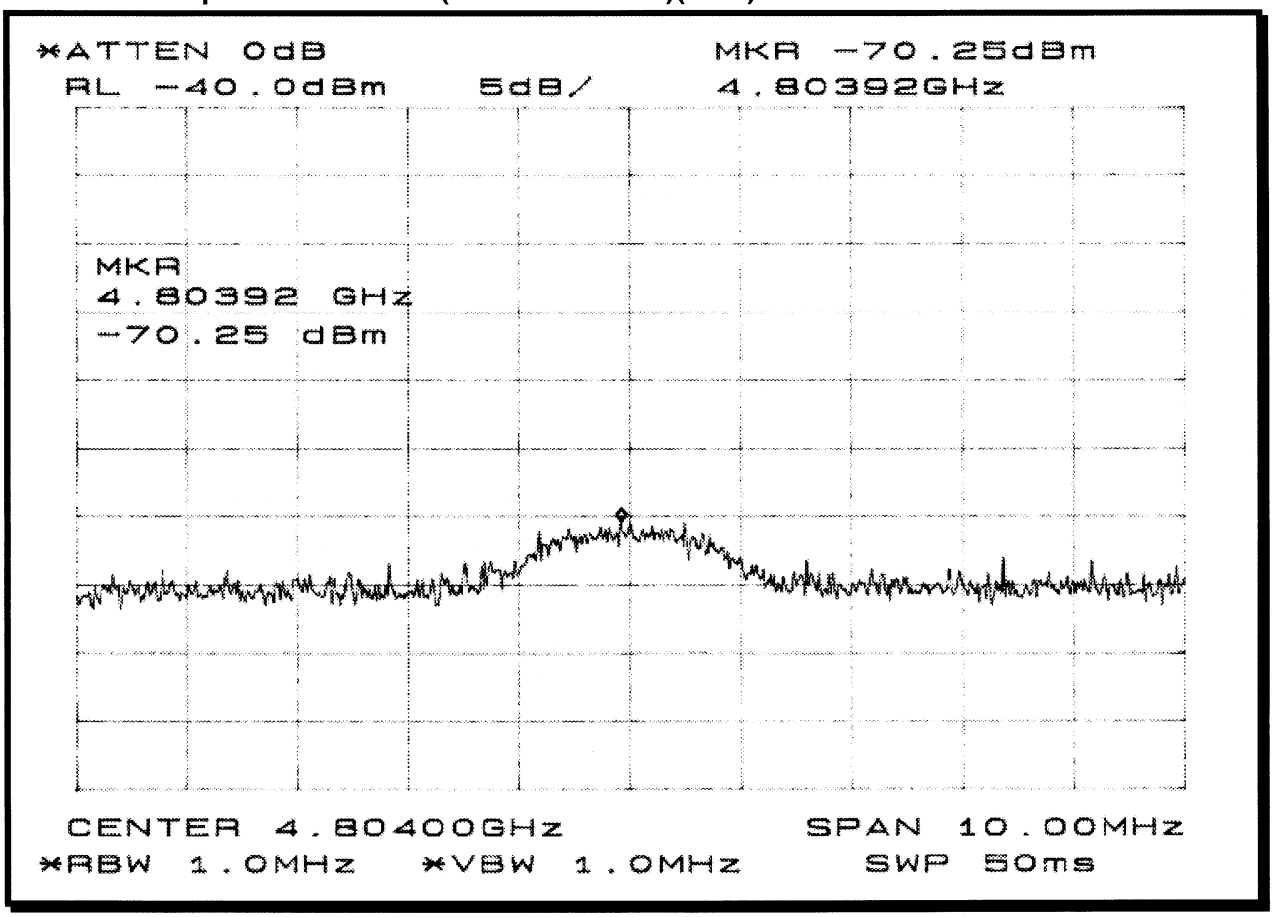


Figure 7: 1st Harmonic of Low Channel

10.3 Radiated Spurious Emissions(Restricted Bands)(cont.)

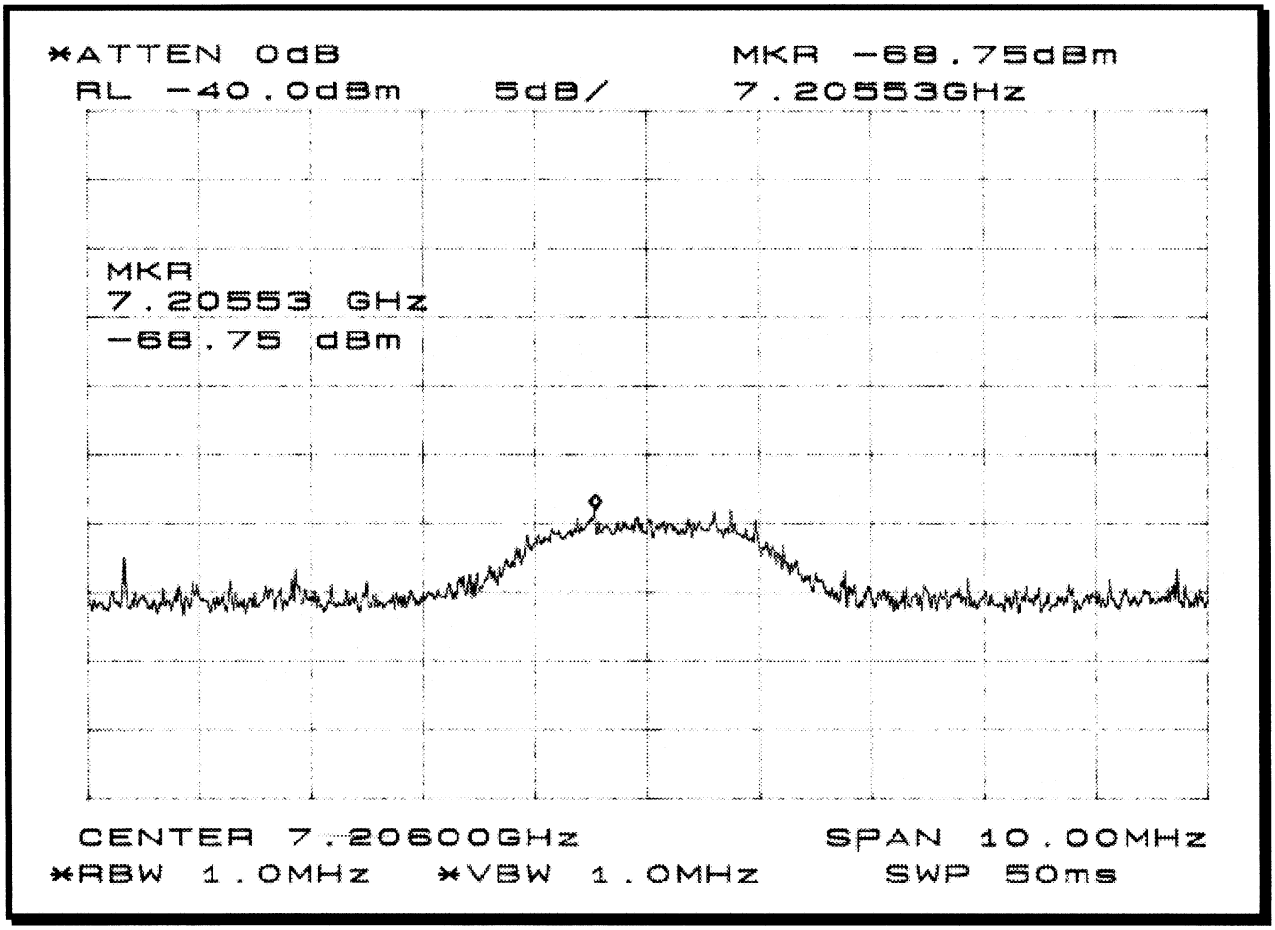


Figure 8: 2nd Harmonic of Low Channel

10.3 Radiated Spurious Emissions(Restricted Bands)(cont.)

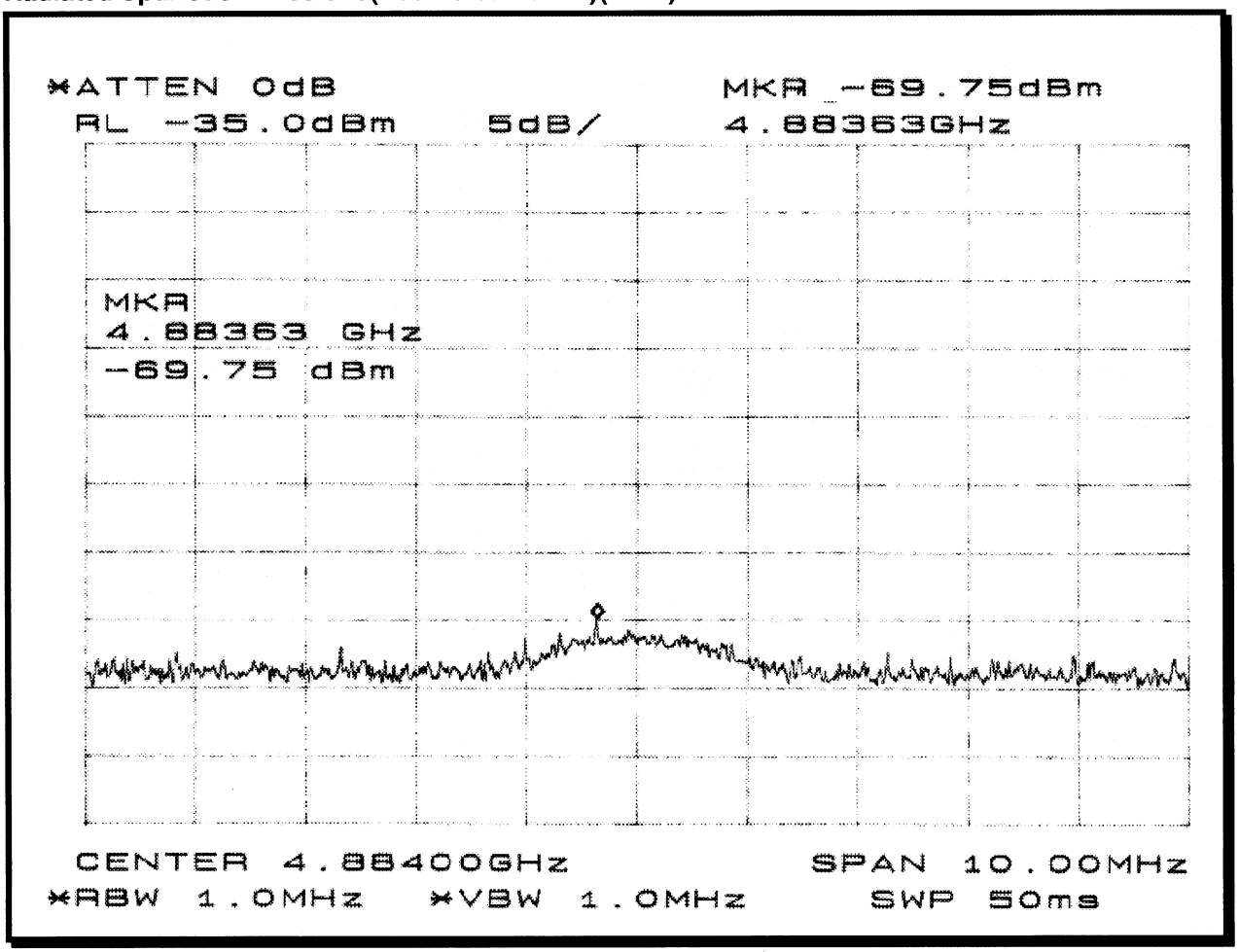


Figure 9: 1st Harmonic of Middle Channel

10.3 Radiated Spurious Emissions(Restricted Bands)(cont.)

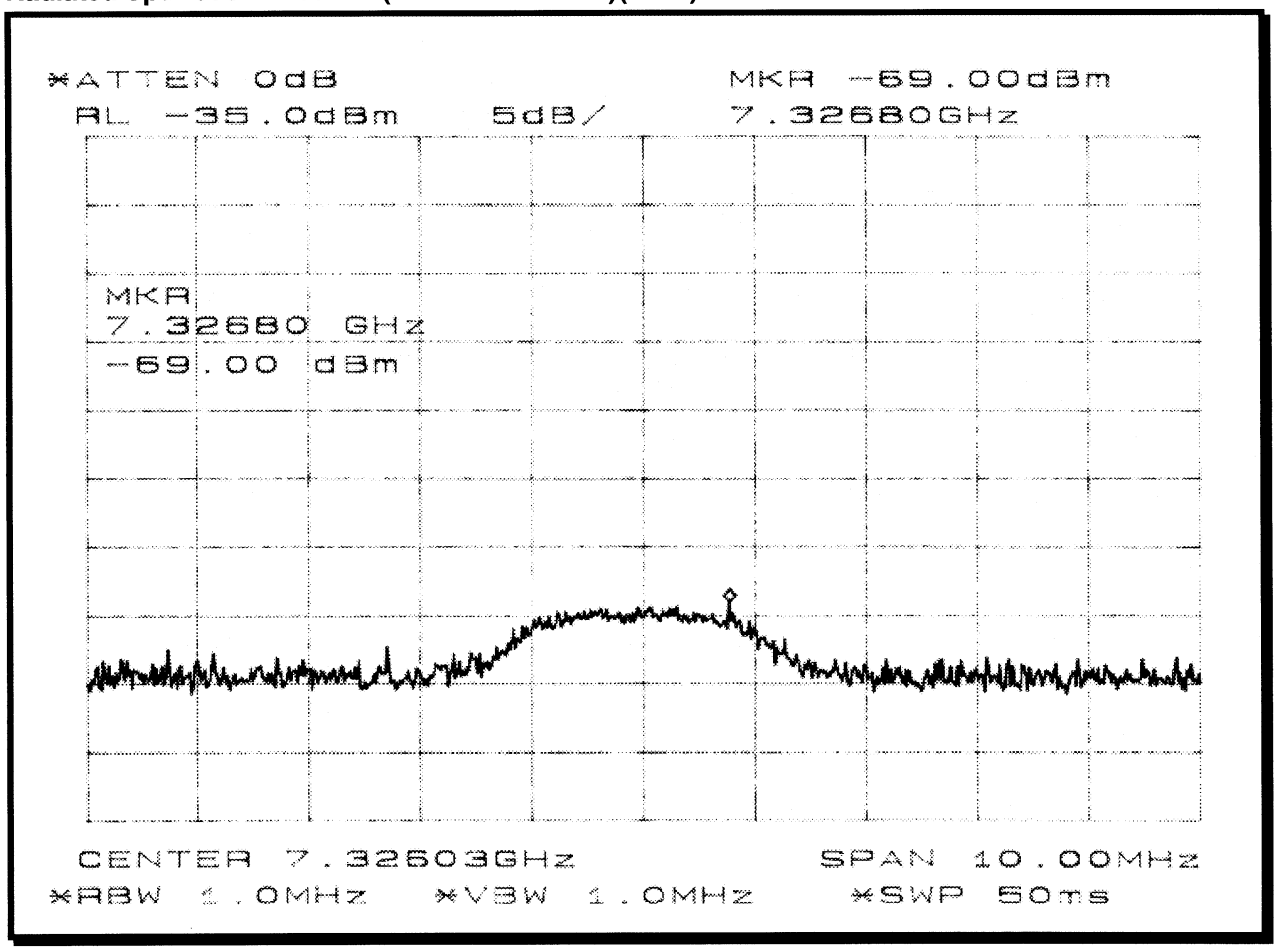


Figure 10: 2nd Harmonic of Middle Channel

10.3 Radiated Spurious Emissions(Restricted Bands)(cont.)

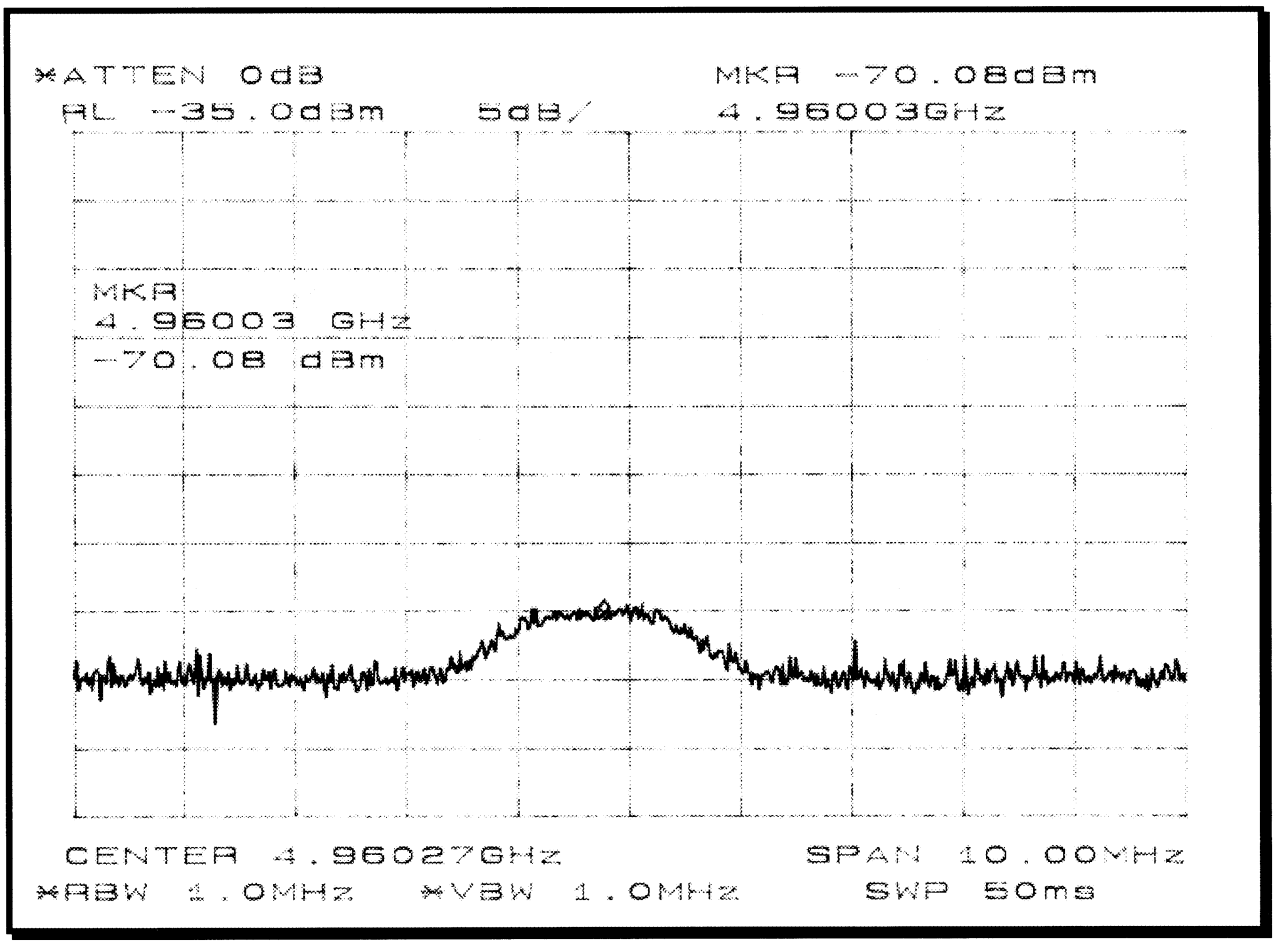


Figure 11: 1st Harmonic of High Channel

10.3 Radiated Spurious Emissions(Restricted Bands)(cont.)

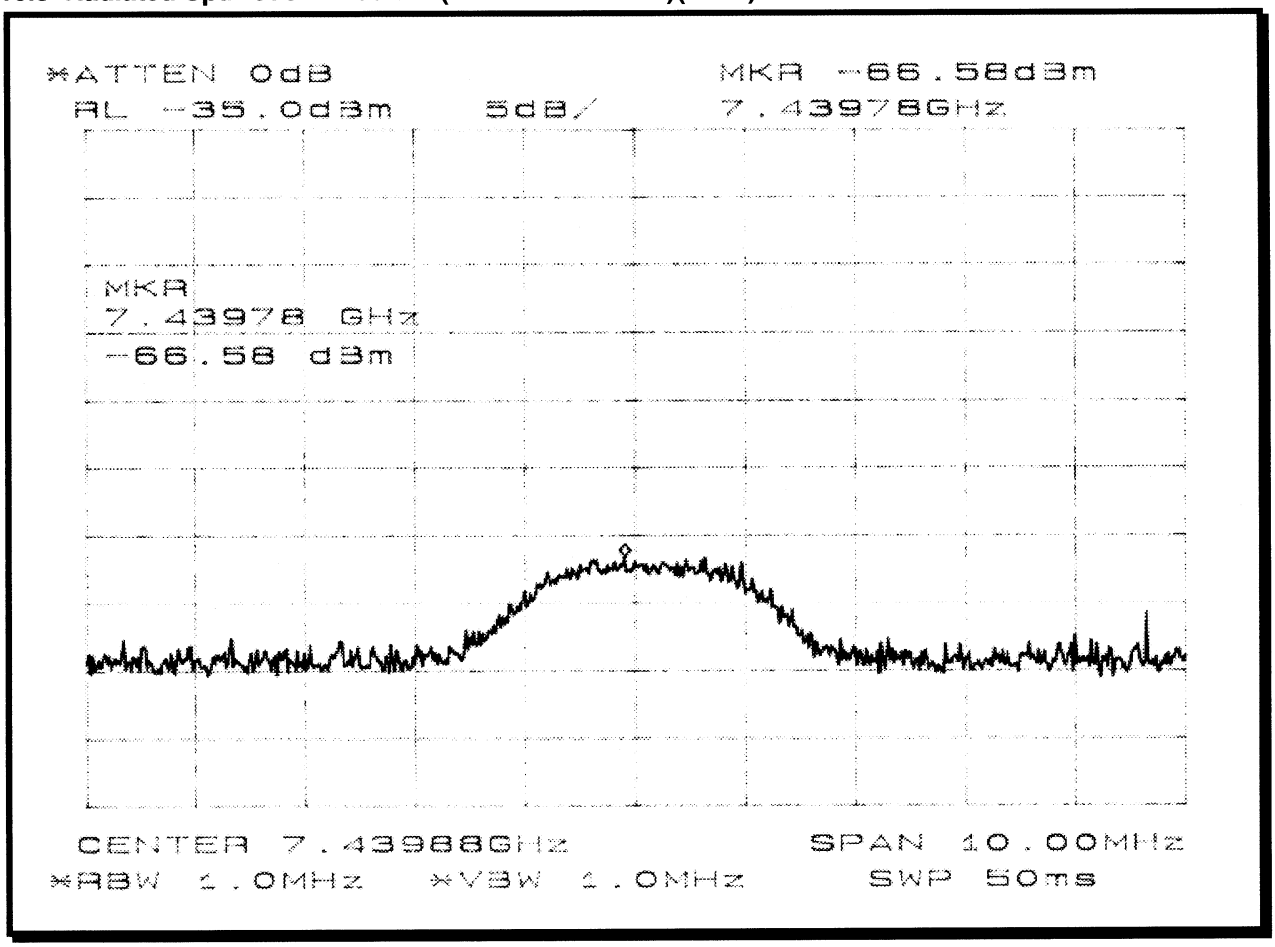


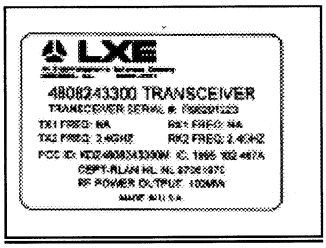
Figure 12: 2nd Harmonic of High Channel

11.0 RF Safety 15.247(b)(4)

The Huber & Suhner antenna is intended to be used in a hand held device, within 20cm of the user. These devices are defined as a portable device by section 2.1093(b) of the rules, and are exempt from MPE requirements. Additionally, the low power of this device excludes it from the SAR evaluation defined in section 2.1093 and by section 3, supplement C of OET bulletin 65.

12.0 SAMPLE LABEL

Radio Label



FCC Compliance Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device must not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Notes

1) The Radio label will be located on the radio card and on the outside of each host side of the device
2) The FCC Compliance Statement is too large for the device and will be located in the manual of each host, in a prominent place.
3) Labels are not to scale, however they will be large enough so that they are legible without the use of magnifying devices.

13.0 CONCLUSION

The product covered by this report has been tested and found to comply with the requirements as described in Part 15, Subpart C, Section 15.247 of the FCC Code of Federal Regulations.

Testing Performed By: Sam Wismer
RF Approvals Engineer

Report Reviewed By: Erik Collins
EMI/EMC Engineer