LXE

125 Technology Parkway
Norcross, Georgia, US 30092

Direct Sequence Spread Spectrum Transmitter

Testing Performed for: EMS Technologies, Inc.
Testing Performed by: LXE Inc.

PRISM System
Model: PAL

FCC ID: DNY722-2

Issue Date: April 19, 1999

Table of Contents

1.0 General **3**
1.1 Introduction 3
1.2 Product Description 3

2.0 Location of Test Facility **3**

3.0 Description of Radiated Test Facility **3**
3.1 Radiated Test Site Illustration 4

4.0 Applicable Standards and References **4**

5.0 List of Test Equipment **5**

6.0 Test Methodology **6**

7.0 Support Equipment **6**

8.0 Test Setup Block Diagram **7**

9.0 Test Setup Photos **8**

10.0 Summary of Tests **10**
10.1 Section 15.203 - Antenna Requirement 10
10.2 Section 15.207 - Power Line Conducted Emissions 10
10.3 Section 15.209 - Radiated Emissions 10
10.4 Section 15.247(a)(2) - Bandwidth Requirement 11
10.4.1 Band Utilization 11
10.4.2 6dB Bandwidth 13
10.5 Section 15.247(b) - Peak Output Power 14
10.6 Section 15.247(c) - Spurious Emissions 15
10.6.1 RF Conducted Spurious Emissions 15
10.6.2 Radiated Spurious Emissions(Restricted Bands) 20
10.7 Section 15.247(d) - Power Spectral Density 25
10.8 Section 15.247(e) - Processing Gain 26

11.0 RF Safety - Section 15.247(b)(4) **26**

12.0 Sample Label **26**

12.0 Conclusion **26**

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 for EMS Technologies, Inc. by LXE Inc., a division of EMS Technologies, Inc.

1.2 Product Description

The equipment under test(EUT) is a single channel, direct sequence spread spectrum transmitter, referred to as the PAL(Personal Alarm) or generically as a PDU (Personnel Detection Unit). The PAL is a single component of the larger Prison Inmate and Safety Management(PRISM) system. The PRISM system uses a series of transmitters and receivers, connected to a main computer for purpose of, among others, monitoring/tracking of prison inmates and guards inside of a correctional facility.

The PAL is a body worn device worn by the correctional officers and is intended to alert the monitoring personnel of a trouble situation. The PAL is equipped with a panic button that the correctional officer can use to activate an "alarm mode" to notify others of trouble. Additionally, the PAL is equipped with a "break away" strap that will also send an alarm condition if the PAL is separated from the strap.

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)

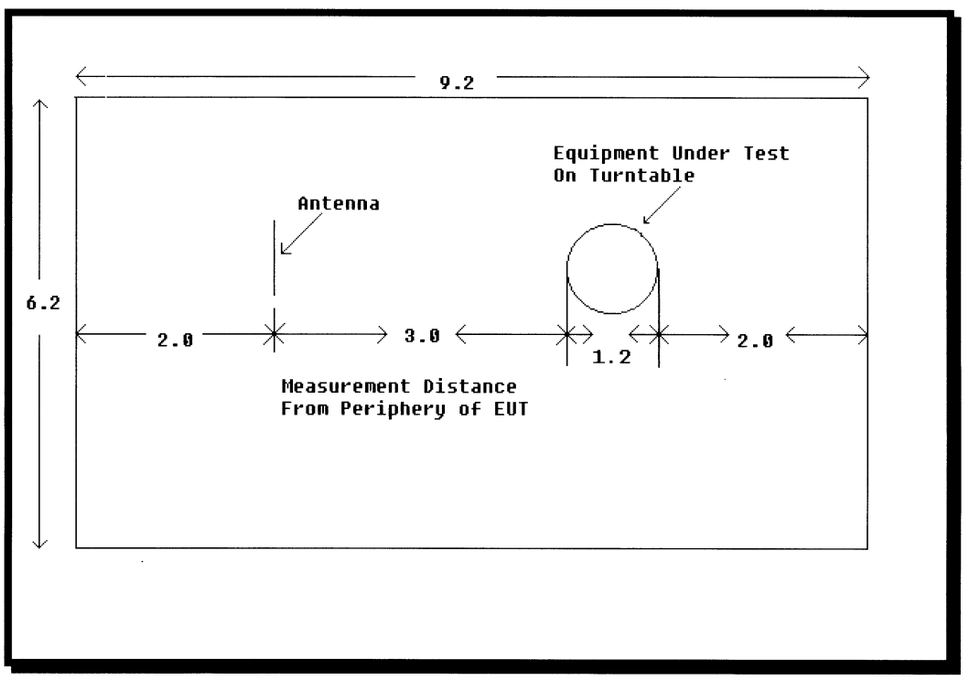

Figure 1: Open Area Test Site(OATS)

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
The EUT is self supporting and required no support equipment				

8.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

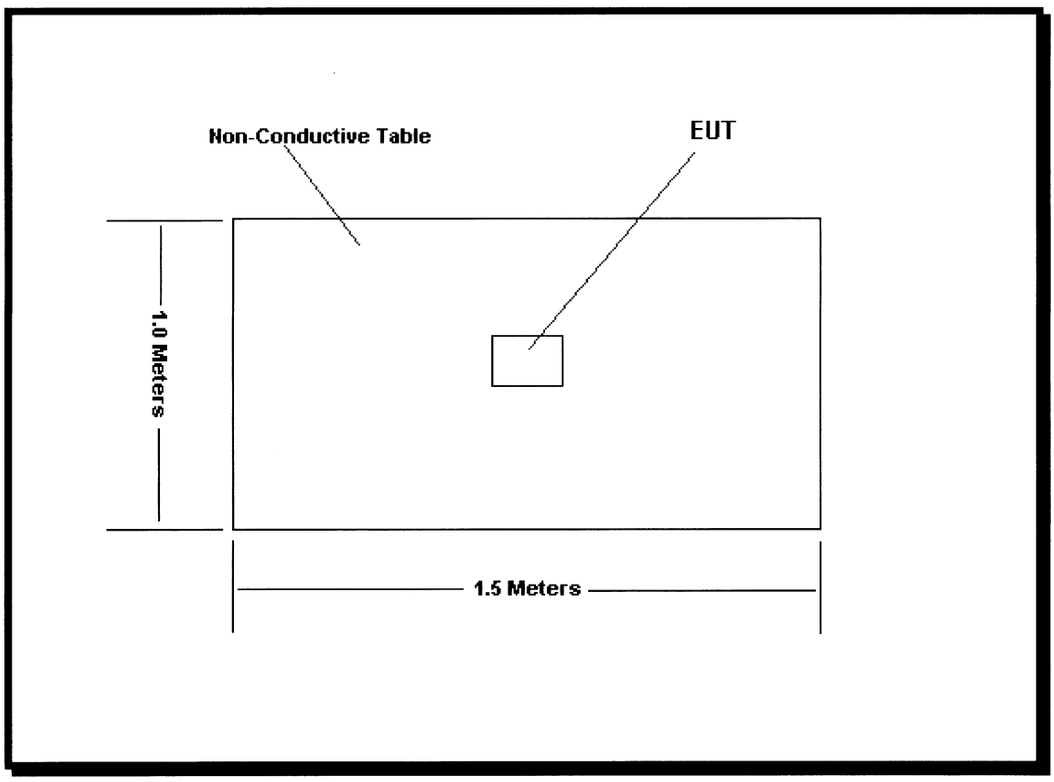

Figure 2

9.0 TEST SETUP PHOTOGRAPHS

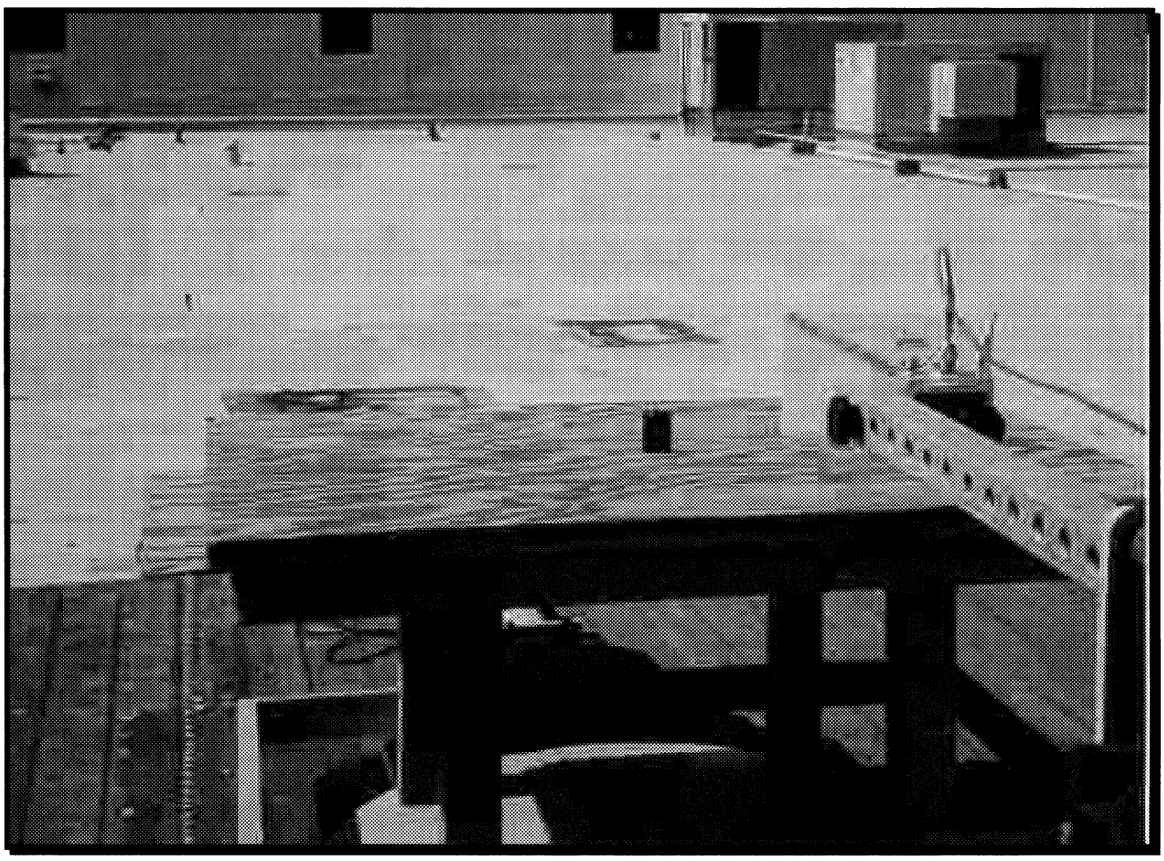

Figure 3: Front View

9.0 TEST SETUP PHOTOGRAPHS(cont.)

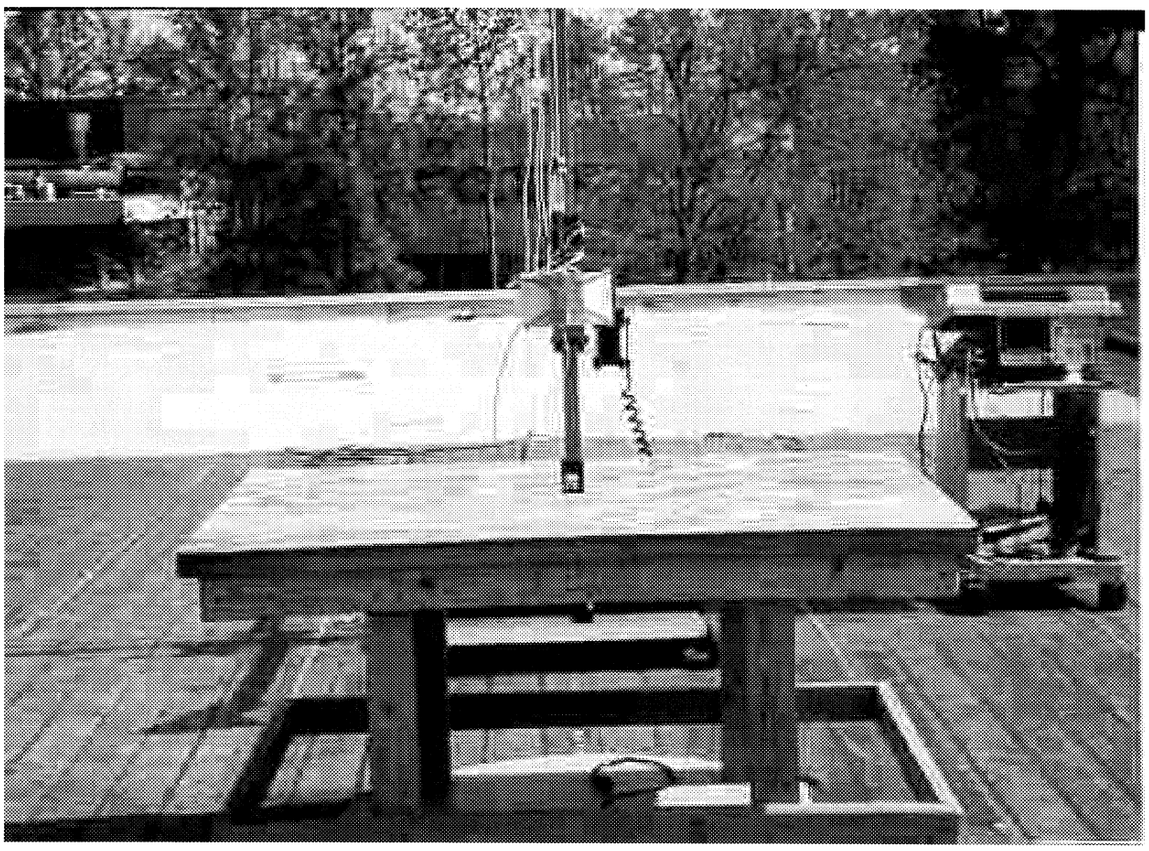

Figure 4: Back View

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 of the PAL unit is etched on a PC board that is located at the top of the device. No antenna substitution can be made without electrical modifications to the unit.

10.2 Power Line Conducted Emissions - FCC Section 15.207

The EUT is powered by a 3.5VDC battery and has no connection to the AC Mains. Conducted emissions are not required.

Table 3: Conducted Emissions

Frequency (MHz)	Level (dBm)	Correction Factors	Corrected Level(dBm)	Corrected Level(uV/m)	Limit (uV/m)	Margin (uV/m)	Pass/Fail
	Conducted Emissions not Required						

Conversions

uV/m = Antilog((dBm + 107)/20)

Sample Calculations

Margin = Limit - Corrected Level(uV/m)

10.3 Radiated Emissions - FCC Section 15.209

The EUT was investigated for radiated emissions from 30 MHz to 10 GHz.

Table 4: Radiated Emissions

Frequency (MHz)	Level (dBm)	Correction Factors	Corrected Level(dBm)	Corrected Level(uV/m)	Limit (uV/m)	Margin (uV/m)	Pass/Fail
	No Emissions detected from 30 MHz to 10 GHz						

Conversions

uV/m = Antilog((dBm + 107)/20)

Sample Calculations

Margin = Limit - Corrected Level(uV/m)

10.4 Bandwidth Requirement - FCC Section 15.247(a)(2)

10.4.1 Band Utilization

The 915 MHz carrier contained within the 902 - 928 MHz band as the following two plots indicate.

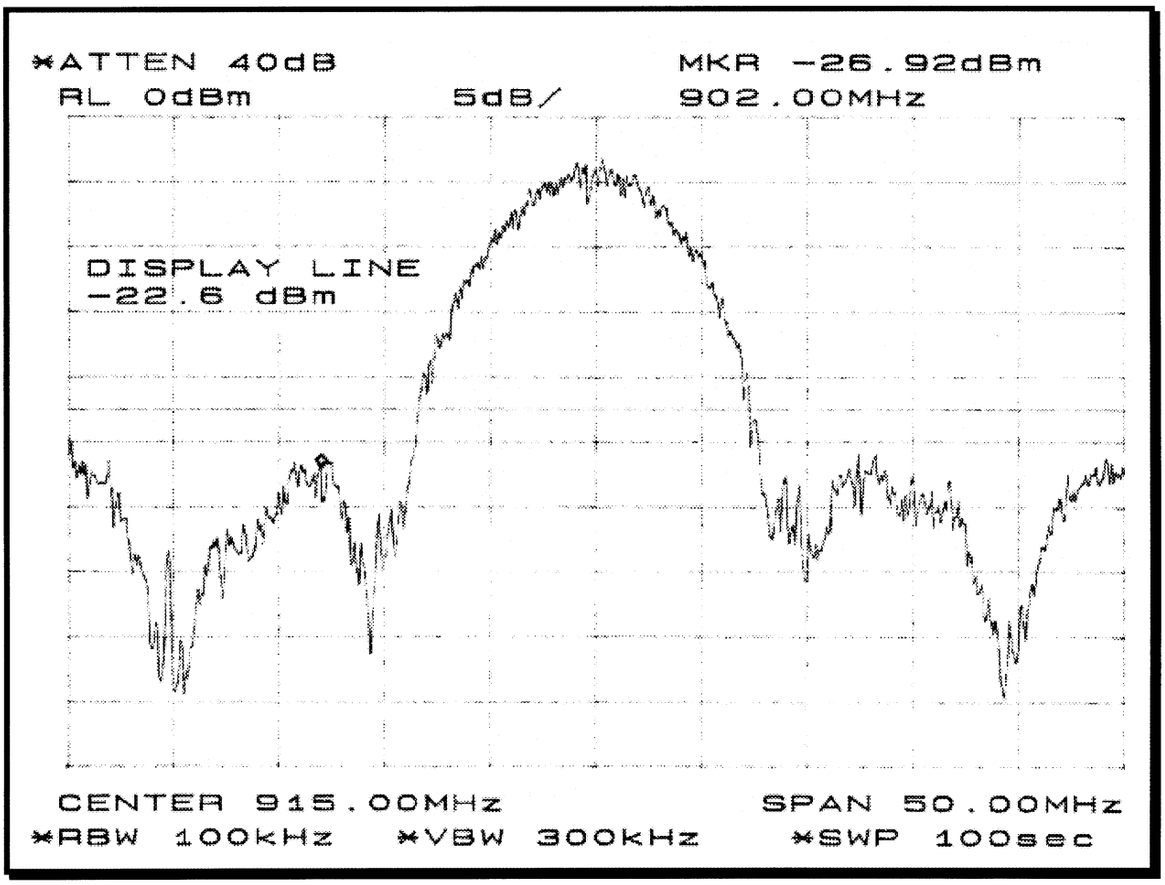

Figure 5: Lower Bandedge

10.4.1 Band Utilization(cont.)

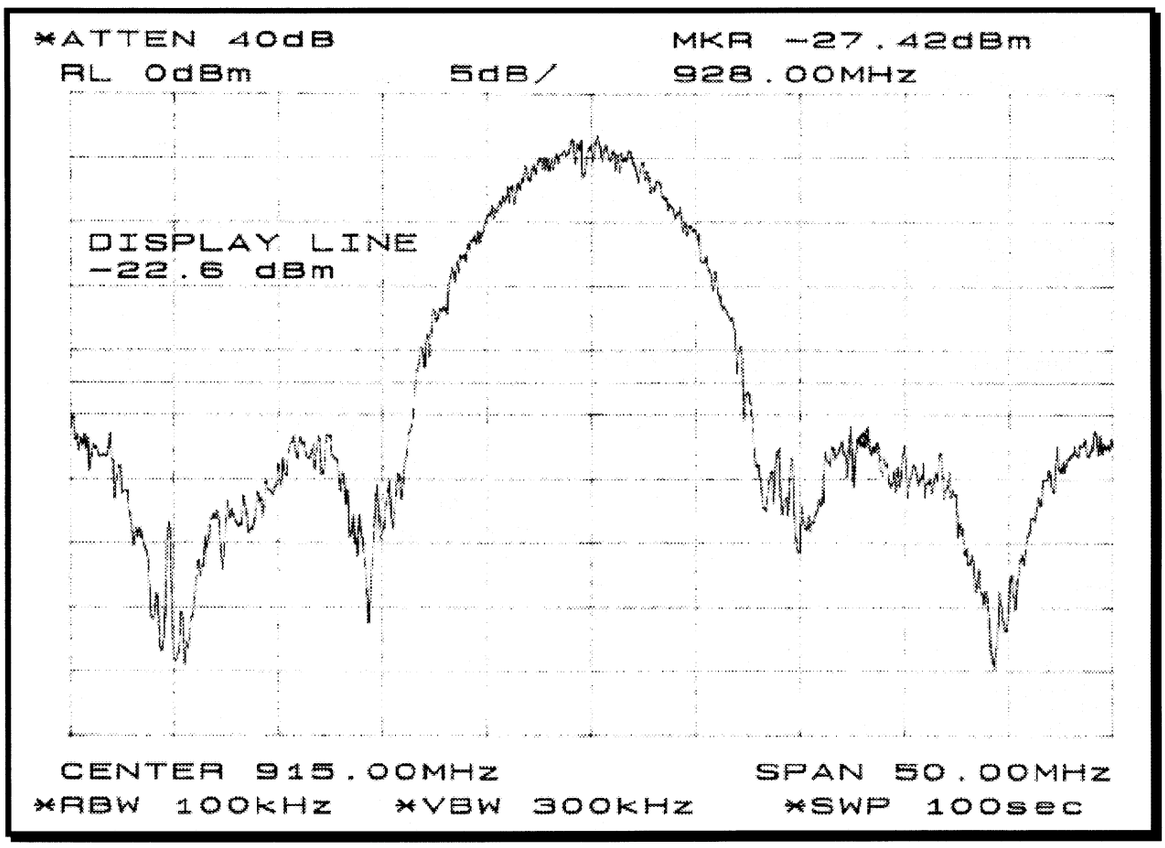

Figure 6: Upper Bandedge

10.4.2 6dB Bandwidth Requirement

The bandwidth of the carrier 6dB down from the peak was found to be 8.42MHz as indicated in the plot below.

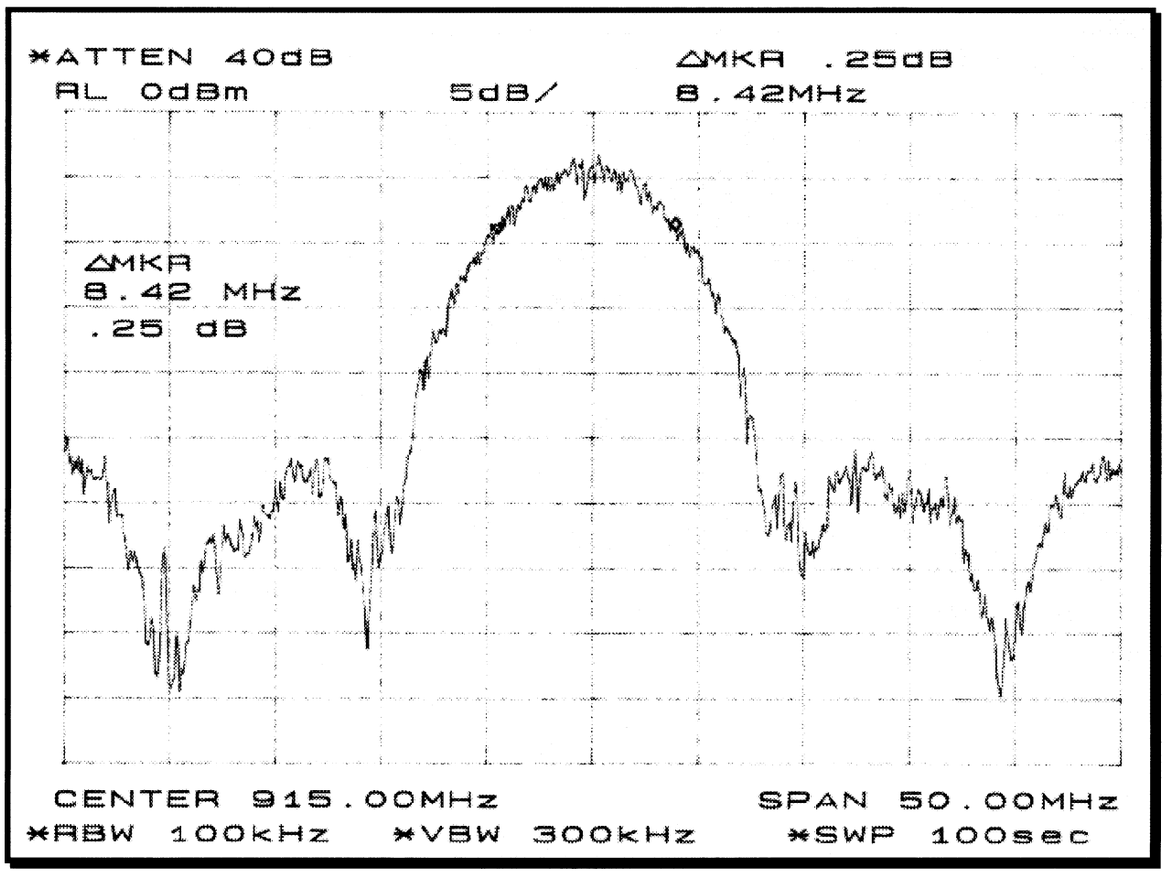

Figure 7: 6dB Bandwidth

10.5 Peak Output Power Requirement - FCC Section 15.247(b)

The peak output power was found to be -2.58 dBm and is in compliance with section 15.247(b).

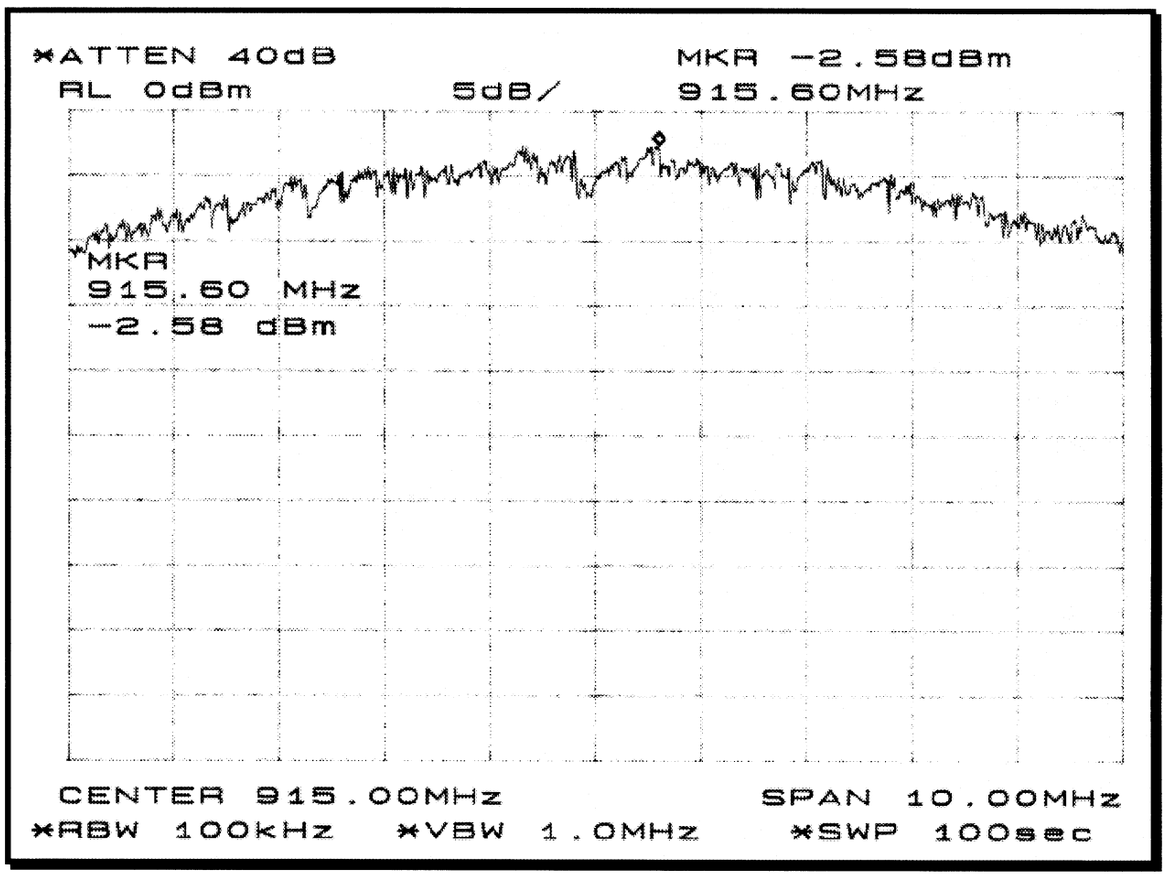

Figure 8: Peak Power

10.6 Spurious Emissions - FCC Section 15.247(c)

10.6.1 RF Conducted Spurious Emissions

The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, which is just over 10 times the fundamental frequency. For each measurement, the spectrum analyzer's VBW was set to 100kHz and the RBW was set to 1MHz.

The RF conducted spurious emissions found in the band of 300MHz to 10GHz are reported below and the following plots were taken to show compliance.

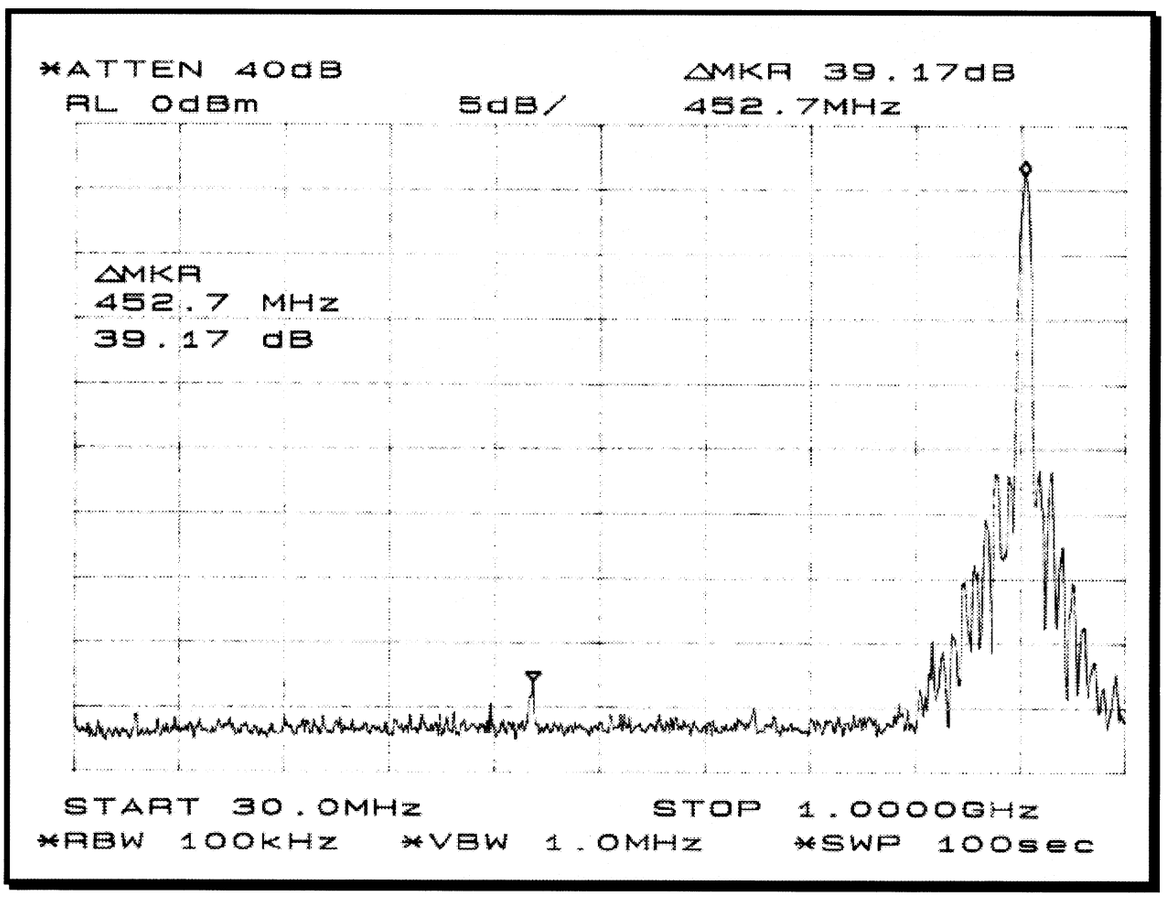

Figure 9: 30 - 1000 MHz

10.6.1 RF Conducted Spurious Emissions(cont.)

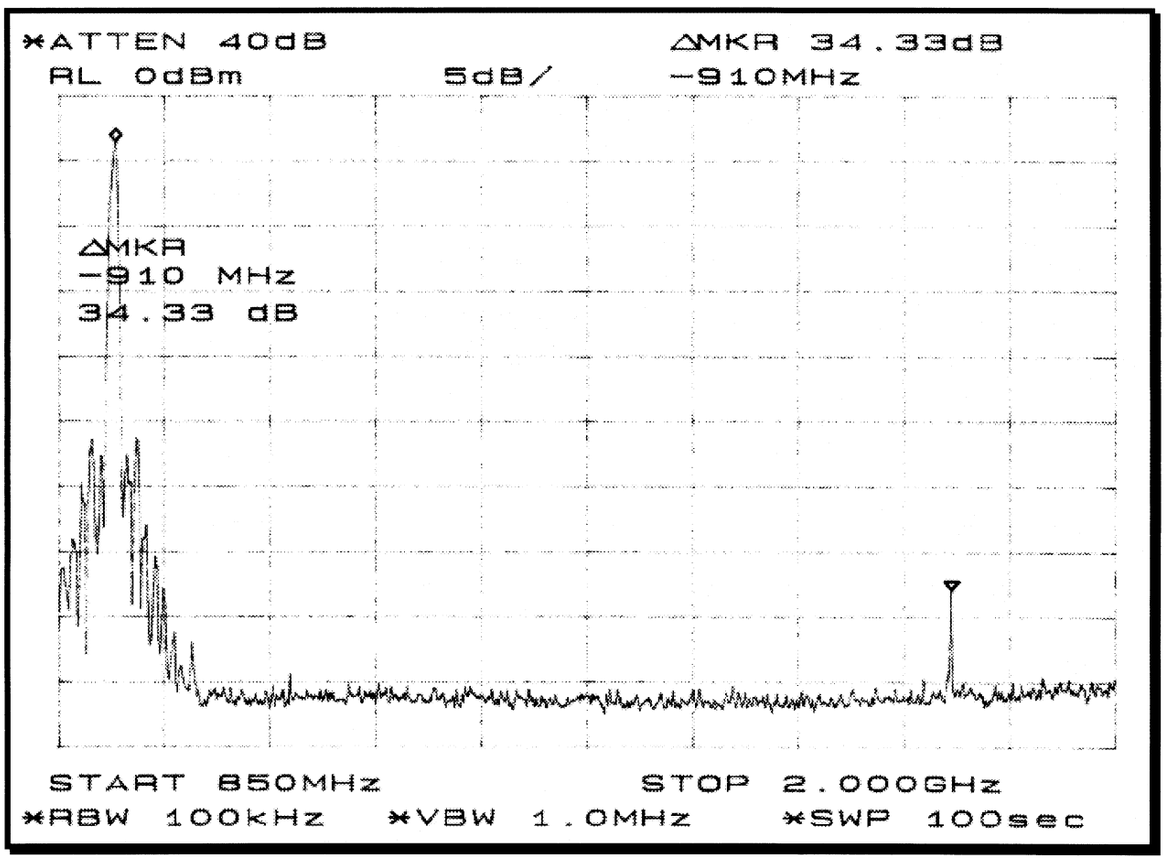

Figure 10: 850 - 2000 MHz

10.6.1 RF Conducted Spurious Emissions(cont.)

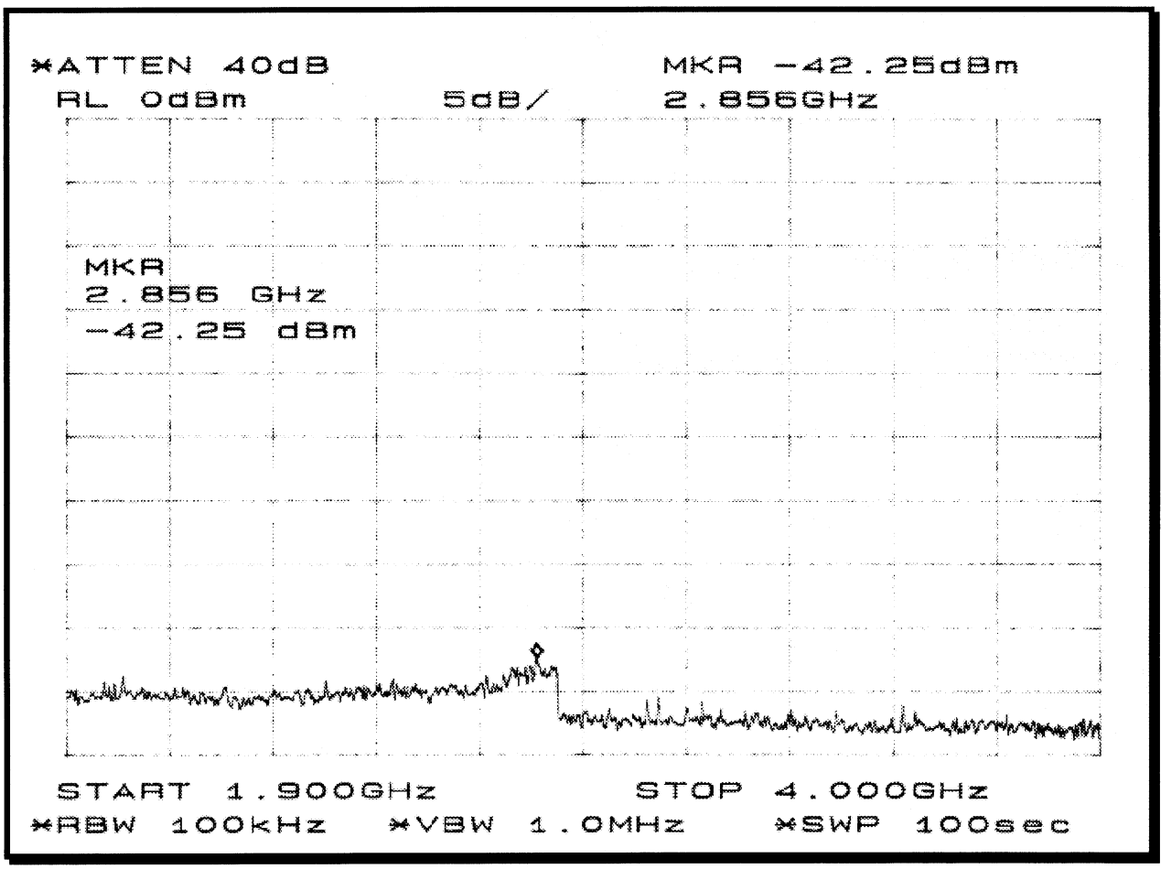

Figure 11: 1.90 - 4.00 GHz

10.6.1 RF Conducted Spurious Emissions(cont.)

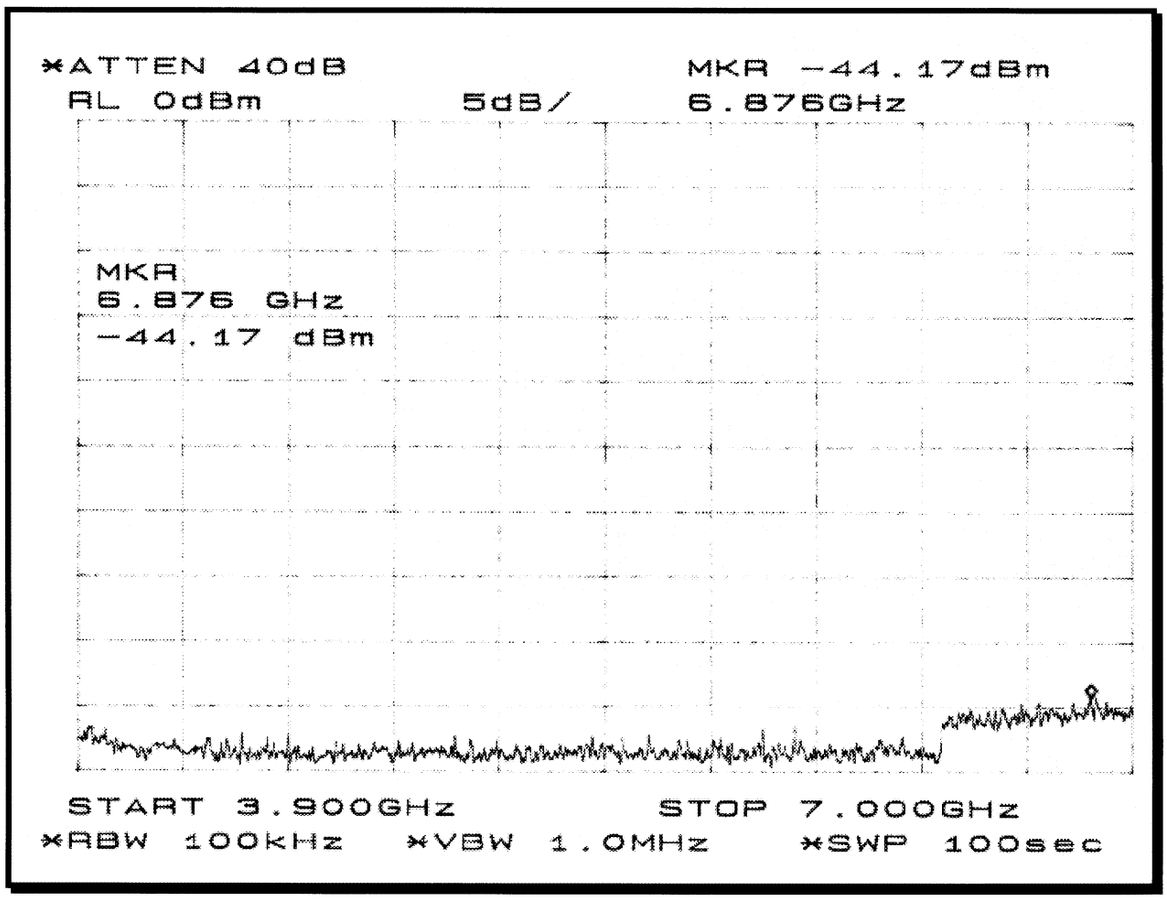

Figure 12: 3.90 - 7.00 GHz

10.6.1 RF Conducted Spurious Emissions(cont.)

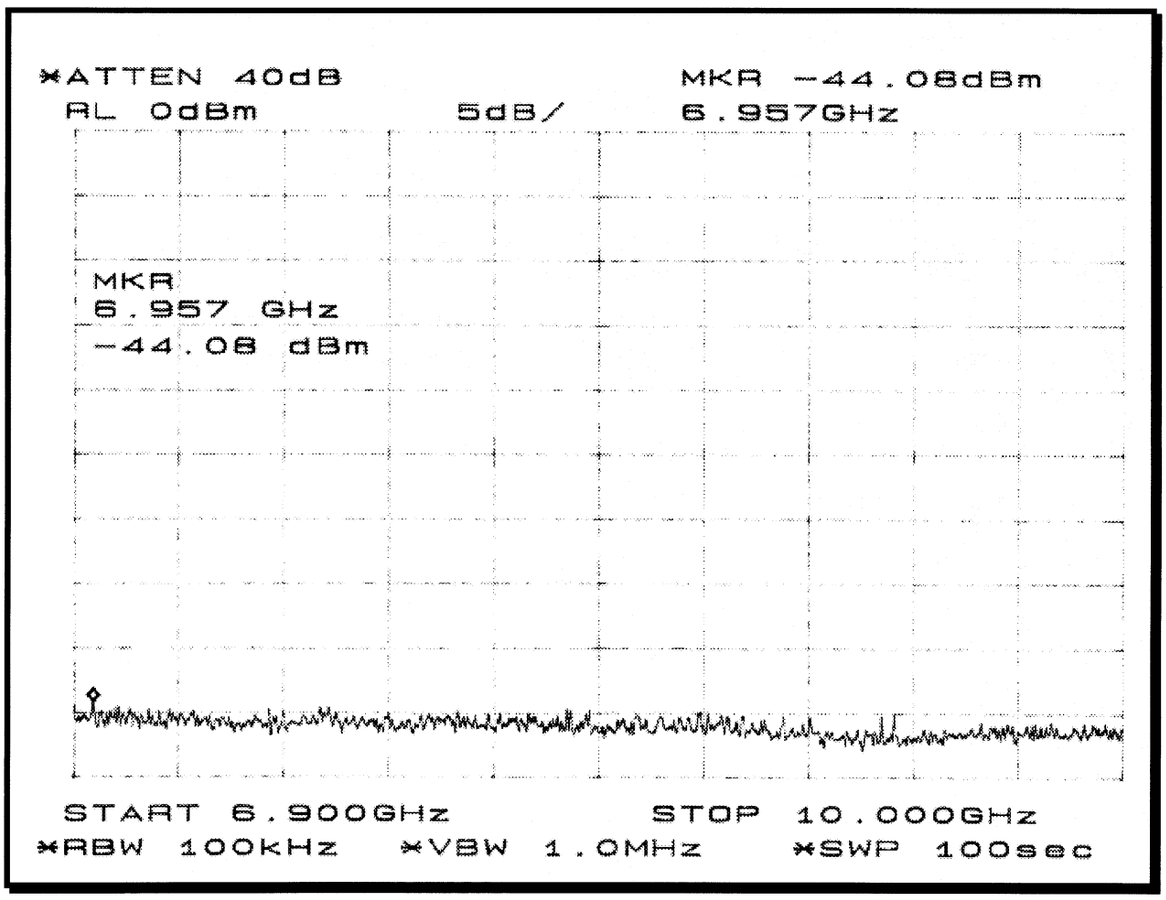

Figure 13: 6.90 - 10.0 GHz

10.6.2 Radiated Spurious Emissions(Restricted Bands)

The 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: Peak Radiated Spurious Emissions in Restricted Bands

Frequency (GHz)	Level (dBm)	Correction Factors	Range Correction	Corrected Level(dBm)	Corrected Level(uV/m)	Limit (uV/m)	Margin (uV/m)	Pass/Fail
Peak Measurements								
2.7448*	-48.08	8.80	9.54	-48.82	810.96	5000	4189.03	Pass
3.6662*	-65.08	11.64	9.54	-62.98	158.85	5000	4814.15	Pass
	No other signals detected above the noise floor							
Average Measurements								
2.7448**	-63.17	8.8	9.54	-63.91	142.7	500	357.3	Pass
3.6662**	-80.18	11.64	9.54	-78.08	27.93	500	472.1	Pass

* Signal 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.

** Due to slow duty cycle, average measurements were calculated. Peak measurements were reduced accordingly. Duty cycle plots are shown following this table.

Correction Factors

Duty Cycle Correction = 20 Log(Duty Cycle) or 20Log(.176mS) = -15.1dB

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)

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

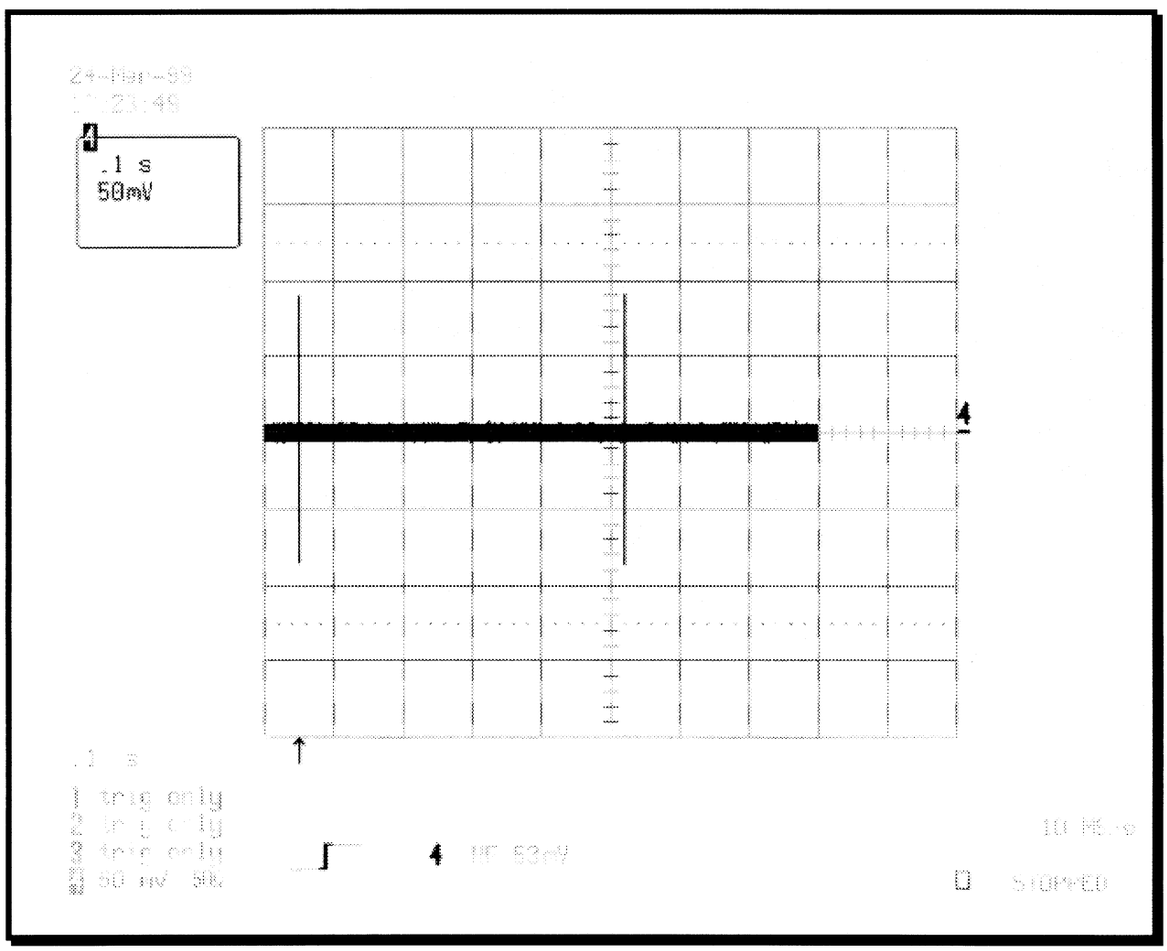

Figure 14: Duty Cycle Plot - One Full Period

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

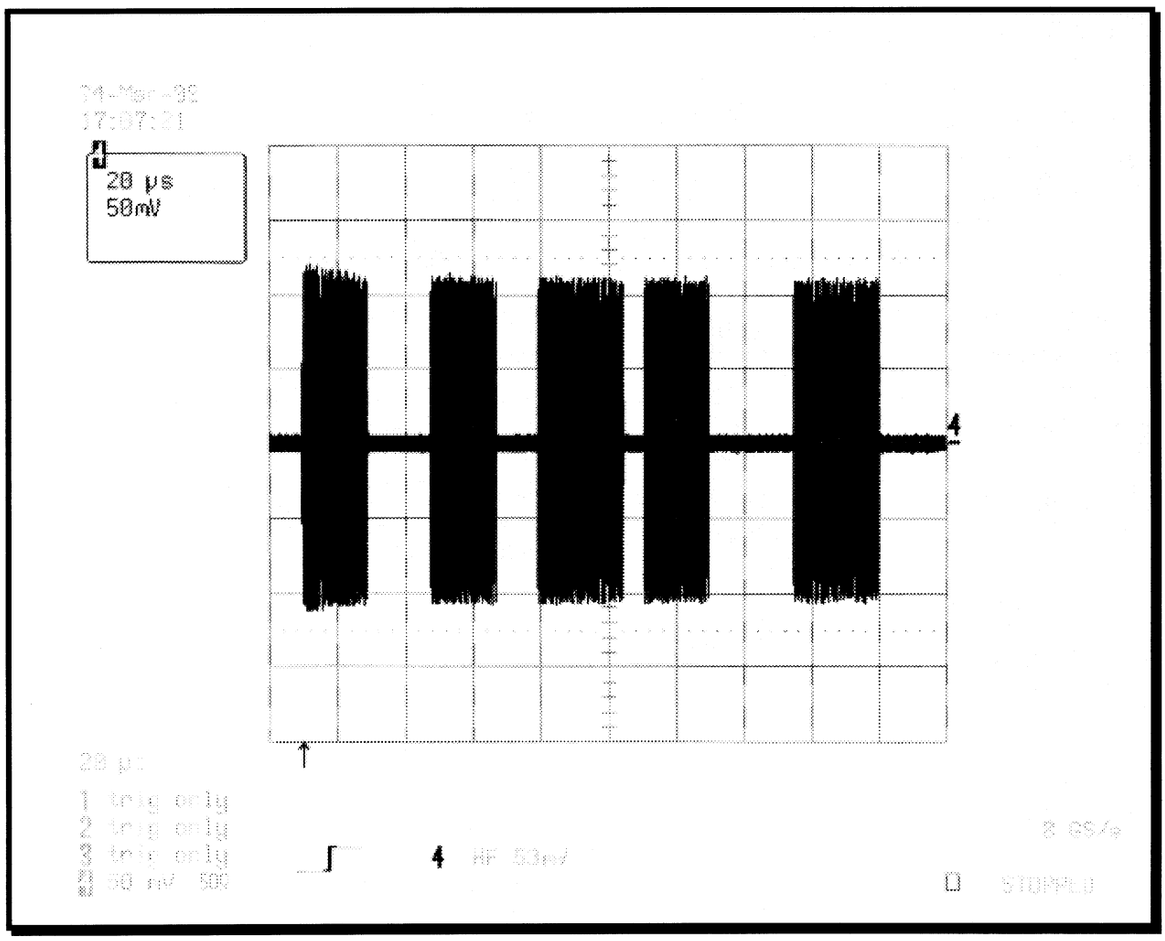

Figure 15: Duty Cycle Plot - Pulse Width

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

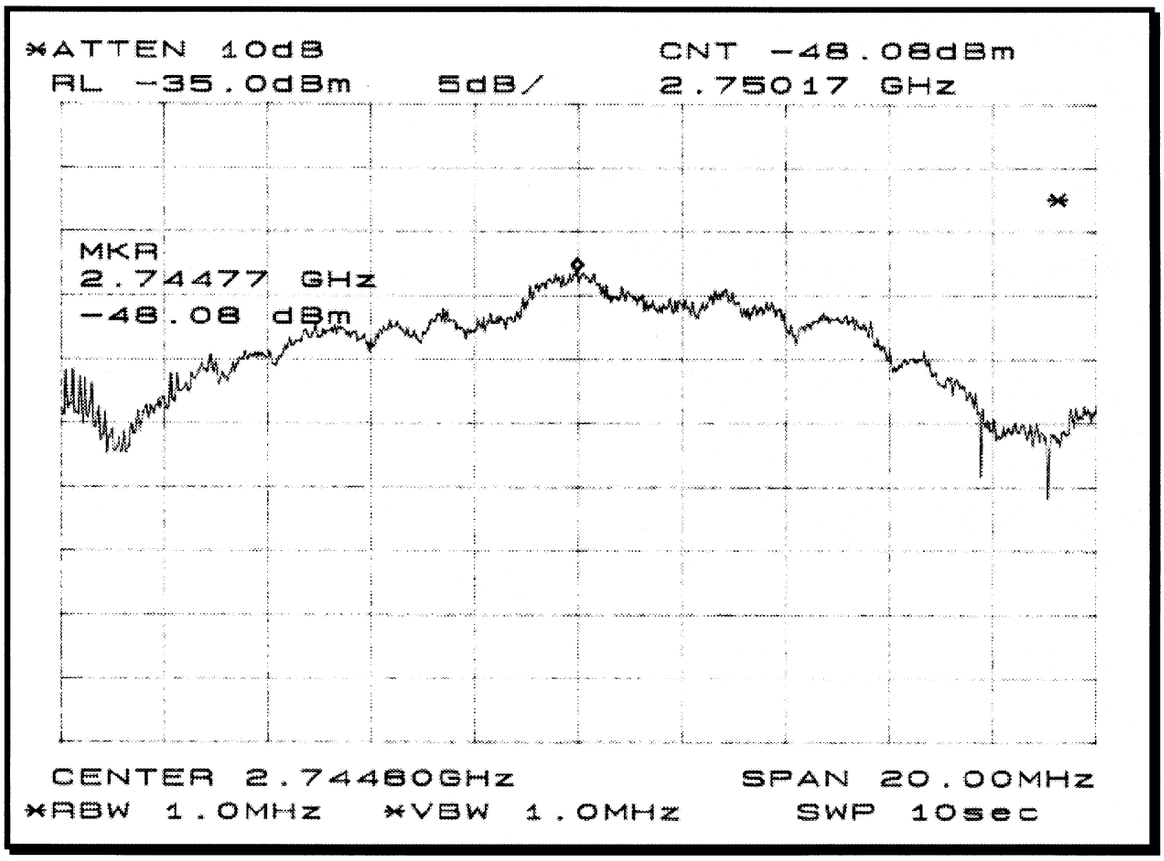

Figure 16: Radiated Spurious Emission at 2.7501 GHz

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

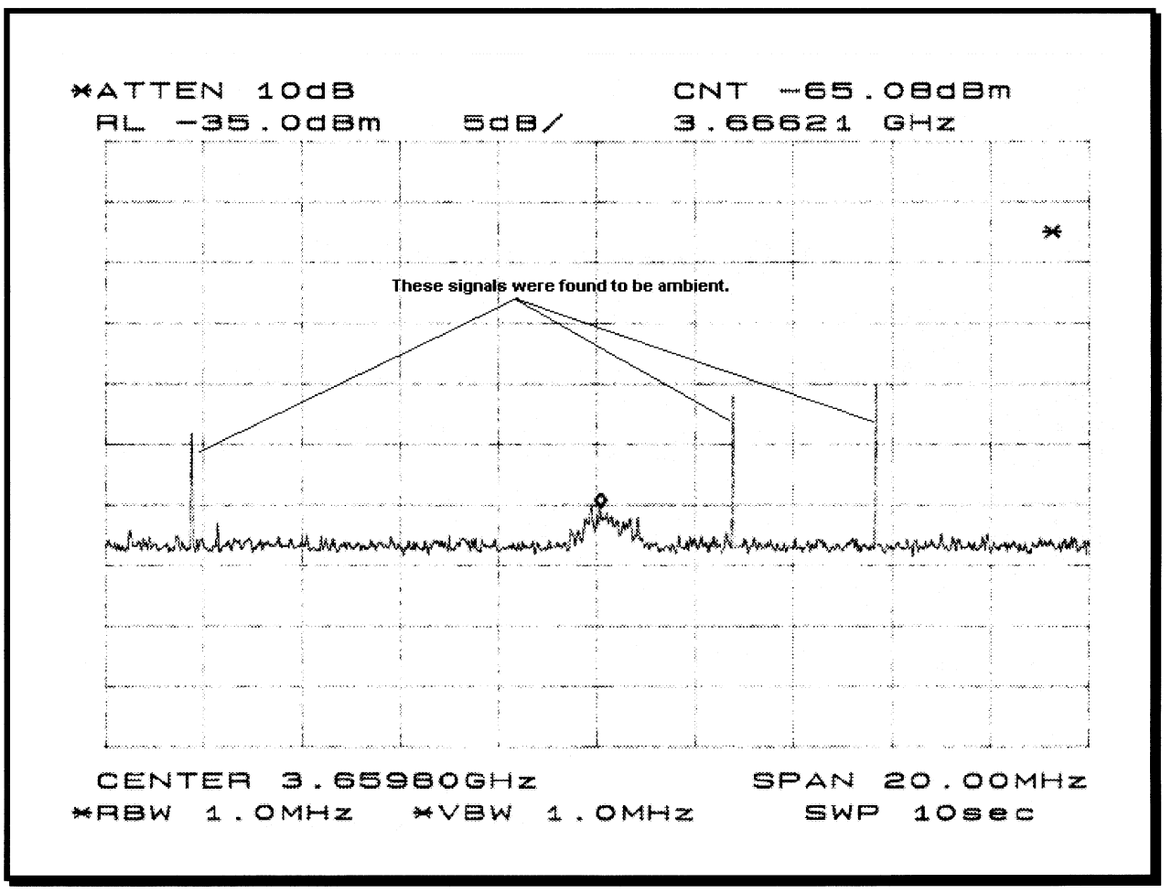

Figure 17: Radiated Spurious Emission at 3.65521 GHz

10.7 Power Spectral Density - FCC Section 15.247(d)

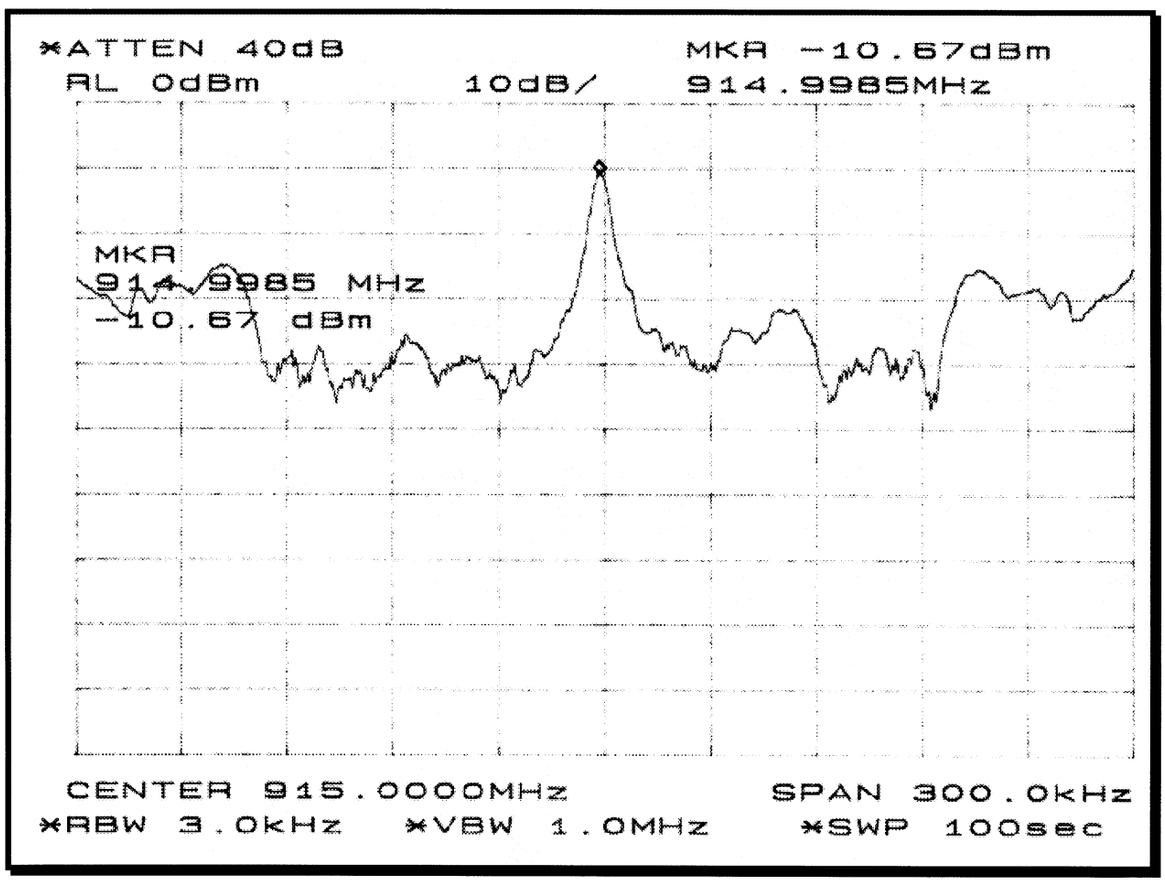

Figure 18: Spectral Density

10.8 Processing Gain - FCC Section 15.247(e)
The processing gain is 17 dB for the transmitter and a minimum of 15 dB for the receiver.

11.0 RF Safety 15.247(b)(4)
This PAL unit is a device is a body worn device not subject to the MPE requirements. Additionally, the PAL is of such low power that it is exempt from SAR requirements as stated in Supplement C, Section 3 of OET Bulletin 65.

12.0 SAMPLE LABEL
The PAL will have 2 labels as shown below will be placed on the back the unit:

FCC Identifier

FCC ID: DNY722-2

FCC 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.

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